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ABSTRACT

This annotated bibliography represents the initial step taken by the authors to apply standards of excellence to the evaluation of literature in the fields of gaming, simulation, and model-building. It aims at helping persons interested in these subjects deal with the flood of literature on these topics by making value judgments, based on the professional competence of the reviewers, about individual works. Forty-eight books and articles are reviewed, covering the years 1898-1971, although most of the works were published in the past 15 years. The majority of these deal with one of the following topics: 1) general game theory; 2) instructional games and simulation; 3) board and table games, such as chess and dice games; 4) war games; 5) the interpersonal and psychological aspects of gaming; 6) gaming and the behavioral sciences; 7) crisis and conflict; and 8) the application of game theory to political and social policy-making. The reviews range in length from a few sentences to several pages, depending upon the individual article or book. (PB)

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Martin Shubik and Garry D. Brewer

A Report prepared for

ADVANCED RESEARCH PROJECTS AGENCY

Rand
SANTA MONICA, CA. 90406

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PREFACE

In 1970 and 1971 Rand conducted an assessment of the state of the art of gaming and simulation for the Advanced Research Projects Agency. The main product of that study was an automated classification and retrieval system for literature on gaming and allied subjects. The system permits publications to be indexed and listed by bibliographic data, evaluative criteria, and subject. Abstracts are included. The classification system is described, and the publications entered in it are listed, in R-620-ARPA, *The Literature of Gaming, Simulation, and Model-Building: Index and Critical Abstracts*, by Martin Shubik, Garry D. Brewer, and Eve Savage.

In the process of writing abstracts for that volume, the authors found that some publications warranted more extended, interpretive treatment than is appropriate in a short abstract. In this report, therefore, are assembled reviews of such publications, which are duly indexed but not abstracted in R-620-ARPA.

Martin Shubik, Professor of the Economics of Organization at Yale University, is a consultant to The Rand Corporation. He spent the academic year 1970-1971 on leave in Santa Monica working on this study. Garry D. Brewer is a member of Rand's Social Science Department.

ACKNOWLEDGMENTS

We gratefully acknowledge the assistance of several individuals in the preparation of these reviews. The diligence and industry of our research assistant Eve Savage, the sensitive editorial skill of Christine D'Arc, and the professional wisdom of several colleagues who responded to our early drafts must be noted. However, we absolve all except ourselves for any comments or judgments made in this report.

INTRODUCTION

The flood of professional publications, which presents an information crisis of the first order, has begun to present a second-order crisis in their evaluation. Most professions are inundated with new literature. Only a few books get reviewed. And those that do are often reviewed poorly. According to a political scientist who recently kept score on reviews of his latest book, the malady has several aspects:

- Books whose subject matter suits them for review in certain journals are not reviewed in those but in other journals that are much less pertinent to the topic.
- The assignment of individual reviewers to books is haphazard and results in incompetent reviews.
- The "non-review" prevails: reviewers peddle their own intellectual wares instead of discussing the contents of the book in question.
- Outright dishonesty occurs: distortion and misquotation shade off into plagiarism.*

In the crush, some scholars are turning to computers to codify and classify articles and books for retrieval by automated systems. Sometimes we fail to ask ourselves: "Is the item worth retrieving?" A simple answer might be: "If it is worth publishing or reviewing in a learned journal, then it is worth retrieving." We wish that this were so; unfortunately, it is not.

In point of fact, very bad books are put out on occasion by intelligent and decent people. This is regrettable. It is even more regrettable when false standards are erected so that nobody is willing to say that a book is bad or to identify as mediocre the results of a sincere but half-baked idea.

In the belief, then, that American professional associations have far too long labored under the stultifying weight of pseudo-objectivity, we have eschewed the conventional forms of "scientism" and "objectivity" in preparing these reviews. They contain value judgments, whose merits will ultimately rest on our professional competence. For example, we give a highly critical review of Buckminster Fuller's presentation on his "World Game" that is almost as long as his account in the *Congressional Record.* We do this because we believe that though Mr. Fuller has

* James A. Stegenga, "On Book Reviews," *PS* (professional newsletter of the American Political Science Association), Vol. 4, No. 2 (Spring 1971), pp. 145-146.

shown great skill in building geodesic domes and other miracles of engineering, published accounts of his work on gaming in international affairs have done the field of gaming a disservice.

Our aim has been to devise standards of excellence based on our professional knowledge and judgment and to apply them honestly, minimizing the pull of personal prejudice. We emphasize that our comments are directed at publications, not at personalities. We admit the fallibility of this, as any, human evaluation system; but we refuse to be cowed by the recognition of imperfection into ignoring the problem.

We believe that in order to reverse the current deterioration in the evaluation of professional publications, a new means of reviewing is needed. We propose that professional associations retain a review panel of ten or so scholars who would engage in a continuous review of publications. All would review the same publications, no matter how briefly, but they would work independently, so as not to develop cliquish biases. Their opinions could be polled by one of several methods available to obtain unbiased group evaluations.* The composite review would then be published in an appropriate journal. For some works, a numerical evaluation would suffice. Others, for example ones on which reviewers strongly disagreed, might warrant more than one interpretive review.

We have chosen to start this process by issuing these reviews. We hope that the gaming profession may thus be encouraged to devote attention and resources to devising systematic procedures to tap a larger cross section of expert judgment such as we have outlined.

* The Delphi Method developed at Rand might be adaptable to this purpose. Conceived as an alternative to simulation in long-range forecasting, Delphi is a means of soliciting the opinions of experts through successive, individual interrogations, during which an expert is fed information about the opinions of other experts and is given a chance to reconsider and revise his views. After several iterations, a statistical group opinion is calculated. See O. Helmer, *Analysis of the Future: The Delphi Method*, The Rand Corporation, P-3558, March 1967, and N. C. Dalkey, *Delphi*, The Rand Corporation, P-3704, October 1967.

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REVIEWS

Clark C. Abt, *Serious Games* (New York: The Viking Press, 1970).

This is a less than serious book about a serious subject. It is not particularly bad, it is not particularly good. It merely has little professional content.

If one views this book as a corporate advertising blurb, it probably fulfills its purpose. The totally uninformed layman would be given an introduction to some of the potentialities of games. Unfortunately, even at this level the introduction is biased to the point of being a virtual sales pitch for using games for almost anything.

The chapters are entitled "Improving Education with Games," "Educational Games for the Physical and Social Sciences," "Game Learning and Disadvantaged Groups," "Games for Occupational Choice and Training," "Games for Planning and Problem Solving in Government and Industry," "How To Think With Games by Designing Them," "How to Evaluate the Cost Effectiveness of the Games," and "The Future of Serious Games."

In the first six chapters the message is "games are good." This part of the book is peppered with statements such as, "Games are effective teaching and training devices for students of all ages." And, "The games lead to conclusions not obvious from the scenario alone and offer the possibility of forecasting individual and group responses to the specific environmental stimuli." Unfortunately, none of these statements is backed up with enough evidence to turn a pure assertion into a reasonable claim. In all fairness, one must note that on p. 18 the author concedes that "the educational benefits of simulation games other than motivational are only dimly understood." But this is the only place in the book where any doubt is allowed to surface. Immediately following it, moreover, is, "The training that games provide in intuition-building, problem solving and social behavior, for example, are of incalculable value." (Actually, since to our knowledge no one has yet calculated the value, "incalculable" is technically correct.)

The chapter entitled "The Cost Effectiveness of Games" contains virtually no information on cost effectiveness. This is especially disturbing when one considers that military games and large-scale diplomatic and military simulations such as one Mr. Abt helped build can cost well over a million dollars and can easily run into many millions. Even simple operational games can be outrageously expensive. Time-shared computer teaching games can be extremely cost-*in*effective, and although there is some evidence that it is possible to produce cheap board games of educational use, the method of costing and validation is still to be developed.

The last chapter, "The Future of Serious Games," is written in lyric style. One gets the feeling that Abt and his associates are dedicated to helping solve the social problems of this world and have "turned themselves on" with their faith in games. We, the reviewers, submit that unlimited faith untempered by professional acumen is a hazardous attitude for the future.

The cost aspects of gaming are critical and must be treated on a professional level. They are not so treated in this book. The control aspects of a game are extremely important. There are good indications that at least for top-level operational games the quality of the game director heavily affects the quality of the game. This may also be true of teaching. Thus, not only will games not replace teachers, but their success may depend on the quality of the teacher using them.

There is no discussion of the importance of the scenarios. No serious evidence is offered for the success of teaching games. No criteria of validation are suggested beyond vague good feeling. There is no discussion of the necessity for a follow-through after a game has been used. What knowledge and information remain two weeks after a game is played? How do we find out? Is it sufficient to justify playing the game?

In short, this book falls somewhere between the possible categories of "scientific but elementary" and "*Reader's Digest*-type exposition." If judged purely as popular writing, it is easy to read, vivid, and may engender some interest and possibly some business from technically uninformed readers. If judged by weightier criteria, it is a very slight volume containing virtually no serious information about serious games.

R. H. Adams and J. L. Jenkins, "Simulation of Air Operations with the Air-Battle Model," *Operations Research,* Vol. 8 (September-October 1960), pp. 600-615.

The Air-Battle Model is a very large-scale simulation of a two-sided global war. It consists of a Plan Converter, the Air-Battle Model proper, and Output Programs. The first and last parts are simply I/O preparation and analysis packages. Only the Air-Battle Model proper is of interest to gamers. It alone contains seven routines: (1) missile launching, (2) bomber launching, (3) tanker operations, (4) bomber cell handling, (5) attrition by enemy defenses, (6) target selection and reconnaissance, and (7) blast damage and radiation effects.

A dominant theme in the report is the virtue of bigness. There are no less than 25,000 possible planes, 3,000 in-flight plans, 1,000 offensive bases, 3,500 targets, 1,500 local defense installations, 1,500 radars, 31 separate bomb types, and 32 different kinds of aircraft. The input preparation routine is some 15,000 instructions long. The magnitude of this operation, besides posing a serious problem of physical management, raises fundamental questions about how data can be obtained to validate the model. Instead of being a virtue, bigness may be an indication of badly stated analytical questions.

Possible applications of the model are described.

R.H.R. Armstrong and John L. Taylor, eds., *Instructional Simulation Systems in Higher Education* (Cambridge, Eng.: Cambridge Institute of Education, 1970).

This is a collection of competent essays covering virtually every use of gaming in England. A fine piece on the prospects for research in higher education is followed by a rather meager description and bibliography of games in education. The next twelve essays discuss the use of war games to train army commanders; the use of gaming in the study of international relations in British universities; the possibilities for simulation research in urban and regional studies; and the use of operational gaming in local government, in the teaching of industrial relations, in simulating a less-developed economy, and in studying social skills.

Many of the ideas derive from work done in the United States. Though the essays are of varying merit, the volume as a whole is more even in quality than similar U.S. publications. There are few dramatic, innovative ideas, but there is also virtually no hucksterism or window dressing (as is common in the American literature).

Richard S. Barton, *A Primer on Simulation and Gaming* (Englewood Cliffs, N.J.: Prentice-Hall, 1970).

This short book fulfills its title very well. Simply written, it makes no attempt to "snow" the reader with science. Simple exercises are appended to each chapter, reflecting the didactic intent. The book begins with a discussion of simulation, models, and theory. Reasons for the use of simulation as a research tool are given, and its various techniques are noted. A chapter devoted to computer systems includes input/output media and memories as well as the systems as a whole. Man-computer simulation and all-computer simulation are the subjects of the next two chapters. The discussion of Monte Carlo techniques is the most technical, requiring some understanding of higher mathematics. It is followed by a chapter on simulation languages. The final chapter, a survey of simulation applications, is the weakest and least satisfactory.

The bibliography at the end of the book is classified in such a way as to indicate that, in contrast with much current practice, the author has read the references he gives. Overall, this is a well-written and useful introduction to computerized model-building and manipulation for the lay reader. Simulation is stressed rather than gaming.

R. C. Bell, *Board and Table Games from Many Civilizations* (London: Oxford University Press, 1960).

In this excellent and fascinating book, Bell classifies board and table games into six categories: (1) race games, such as pachisi, (2) war games, such as chess, (3) games of position, such as "naughts and crosses," (4) *mancala* games, such as *wari*, (5) dice games, and (6) domino games.

Mancala games, which are found almost solely in Africa, use a board having several small, deep depressions, rather like an egg carton. Depending on the particular *mancala* variety, the game is played by systematically either emptying or filling the depressions.

Bell classifies *Go* as a positional game. The reviewers believe that it should also be classified as a war game: in some ways *Go* is more of a war game than chess is.

Bell notes that towards the end of the eighteenth century in England, games of pure amusement were followed by a host of games of similar design but intended for educational purposes, teaching children

> history, geography, architecture, botany and astronomy. Occasional copies may still be found in old books or antique shops; delightful hand-colored sections mounted on canvas and contained in slip cases or between boards similar to modern road maps on cloth.

The names and playing methods of games have changed in curious ways. Tennis, for example, was invented under the name *sphairistike* by a Major Wingfield in England, ca. 1874; later it became known as lawn tennis. Bell reports that a board game called the Sumerian Game was discovered by Sir Leonard Woolley. That calls to mind a completely independent "Sumerian game" recently devised as a teaching aid in economics (see below, pp. 00-00). The precursor of chess, a Hindu game known as *shaturanga*, originally used dice to determine the order of moves. When gambling was proscribed, in early Hindu society, *shaturanga* is thought to have been adapted by discarding the dice, thus removing the element of luck from the game.

Symmetry is an important aspect of games, and most are symmetric. But the nature of operational games generally demands that they be nonsymmetric. Rarely is nonsymmetry handled effectively. When a nonsymmetric game has perfect information, the advantage automatically goes to one side. In an extremely nonsymmetric game called "The Maharajah and the Sepoys," the Maharajah plays singly against all the chessmen of the other side. His only advantage is in being able to move as a queen or a knight and being able to start the game at any free square on the board. The game in other respects is a certain loss for the Maharajah if the other side plays correctly.

The book ends with biographies of ten prominent men of games from the tenth to the twentieth centuries. They include As-Suli, who wrote a book on chess in the early tenth century; Charles Cotten, author of *The Compleat Gamester* in the seventeenth century; Edmond Hoyle, who wrote treatises on backgammon and whist; and Edward Falkener, who wrote *Games Ancient and Oriental* near the end of the nineteenth century (see below, p. 00).

Edmund Bergler, *The Psychology of Gambling* (New York: Hill and Wang, 1957).

This is an unsatisfactory treatment of the psychopathology of gambling and risk-taking. The author, a psychiatrist, believes that all gamblers invariably play to lose, but he distinguishes between gangster-racketeers and "neurotic sucker-gamblers," focusing on the latter. Dr. Bergler's psychiatric qualifications may be unim-

peachable, but his book shows little understanding of the difference between games of chance and games of strategy—witness his discussion of chess and poker. This book has merit mainly because of the lack of other literature on the subject.

Eric Berne, *Games People Play* (New York: Grove Press, 1964).

This is simultaneously a highly stimulating and a slight book. It is valuable in highlighting the game-playing and role-playing aspects of interpersonal relationships. Furthermore, by doing so in a readable and popular style, it has both captured the imagination of a large and somewhat uncritical audience and has raised the hackles of many psychiatrists, who feel that this is a professional betrayal. Notable for those interested in gaming are some useful observations on the nature of role-playing and the problems of describing the relations among people in both formal games and games that are not necessarily planned.

A. Blaquiere, F. Gerard, and G. Leitmann, *Quantitative and Qualitative Games* (New York: Academic Press, 1969).

According to the preface, "this volume is addressed to those interested in game theory for its own sake, as well as to those concerned with conflict situations in technology, economics, psychology, indeed, in any dynamical system." On the contrary, this book is for the specialist in differential games and control theory. A work of mathematical virtuosity, it is too abstract and far removed to have an evident connection with the behavioral sciences.

Games are divided into two general categories, which can be described by differential equations and by difference equations. *Quantitative* games are those that have numerical payoff functions, and *qualitative* games are those in which the players do not strive to minimize or maximize a numerical payoff but pursue conflicting aims, attempting to terminate play on different target sets. Implicit in this approach is the view that games are usually two-person zero-sum games and occasionally two-person non-zero-sum games, for which Markovian strategies are employed, i.e., strategies that do not depend on historical detail but on the state of the game. For such restricted strategies, solution is a saddle point or an equilibrium point of the game. This concept of solution is not fully substantiated, and the meaning of strategy in a dynamic context is not thoroughly explored. Such omissions are common in attempts to apply control theory to game theory. Undoubtedly there is a broad class of phenomena for which this type of model and these restricted strategies are reasonable—for example, to approximate the damage exchange between fighting forces. But in general this type of model does not apply to the behavioral sciences.

Although the reviewers do not feel technically qualified to judge the finer mathematical points of this study, they suspect that it may be a valuable contribution to the literature on mathematics and control theory. As such it will be of indirect value to the behavioral scientist.

D. F. Blumberg, *The City as a System* (Jenkintown, Penn.: Decision Sciences Corporation, 1969).

This report is a sales pitch for computer simulations. The author, president of a consulting firm, argues that the inordinate complexity of the urban environment demands interconnected, sophisticated analytical techniques to make decisions and to manage that environment. After providing a brief and factually inaccurate analysis of the use of computer models in urban studies to date, he is moved to comment, "[We] felt enough had been done to enable us to take a first step toward developing a new set of models aimed at describing the city system as a whole" (p. 14). What follows, predictably, is a series of flow charts of the "Urban System"; a display of this firm's wares, a simulation called SCANCAP, including ten or so pages of "Typical Printout" of the model's outputs; and summary charts and graphs of the various policy alternatives that have been explored with the model.

The final comments are so typical of this class of entrepreneurship that they bear quotation to acquaint the unfamiliar reader with the genre:

> ...a first attempt to quantitatively structure the city as a dynamic system, using the computer and operations research techniques. The methodology allows us to *begin* the exceedingly difficult task of predicting community characteristics over time; exploring the types of government action; and examining the future impact of individual projects, alternative project mixes, and budget levels. It provides us with a beginning to examining alternative organizations and types of communities. (pp. 48-49)

At the risk of being dogmatic, the reviewers offer the following statements as caveats to bear in mind when considering such schemes.

- There is not now and most probably will never be a *general* urban simulation model.
- No social simulation has been developed with convincing predictive power.
- Since policy is future-oriented, models that have weak or no predictive power are risky to use in testing policies.
- No small-scale operation is going to accomplish a prodigious task within the limits of a small, time-constrained contract.

Publications such as this diminish the prospects for financial support of serious gamers and simulators. We therefore believe it in the professional community's interest to review such publications critically.

Sarane S. Boocock and E. O. Schild, eds., *Simulation Games in Learning* (Beverly Hills, Calif.: Sage Publications, 1968).

This is a collection of short papers on the potential utility of games as teaching devices. They cover the rationale, specific parameters, and effects of so using games, closing with a discussion of the prospects for the future. The articles vary from extremely poor to excellent. Noteworthy are four or five articles—three by Inbar, Farran, and Zaltman—that describe instances of the use of certain games in teaching and the attempts to measure their impact.

What is surprising is the complete neglect of the structural and theoretical aspects of games. To read this book one would think that war gaming never existed and that the theory of games has nothing to do with structuring problems dealing with conflict, competition, and cooperation. This lack is particularly noticeable in the several discussions of the roles of strategy, motivation, and payoff.

To its credit, this book makes a serious attempt to come to grips with some of the problems and possibilities in the use of games in education. More of such work would be welcome.

Ira R. Buchler and Hugo G. Nutini, *Game Theory in the Behavioral Sciences* (Pittsburgh: University of Pittsburgh Press, 1969).

This book, in whose title "Behavioral Sciences" should be replaced by "Anthropology," stems from the interest that several anthropologists have expressed in using game theory to develop a "meta-language" for anthropology. The notion of applying the formal apparatus of game theory to problems in social and cultural anthropology is intriguing. And the titles of some of the papers suggest a laudable attempt: "A Game Model of African Tribal Politics," "Game Theory, Cultural Values and the Bride Price in Africa," "Formal Analysis of Anthropological Economics: The Rossel Island Case." But the results do not meet professional standards—at least for game theory. The problem is that anthropologists do not know much game theory, and game theorists do not know much anthropology. The meeting of the two disciplines might be more fruitful if the gaming component consisted of specialists in *gaming* rather than game *theory*.

Roger Caillois, *Of Man, Play and Games,* translated by Barash Meyer (New York: The Free Press, 1961). Originally published as *Les Jeux et les Hommes,* 1958.

In this excellent study, the author pays tribute to the earlier work of Huizinga but believes that he minimized the diverse forms of play and the many needs that play serves in various cultures. Caillois defines play in such terms as "free," "separate," "uncertain and unproductive yet regulated," and "make-believe." He classifies games under four categories: (1) *agon* (competition), (2) *alea* (chance), (3) *mimicry* (simulation), and (4) *ilinx* (vertigo). The categories may be linked in certain conditions. For example, many Australian, American Indian, and African cultures evince the *mimicry-ilinx* complex by emphasizing masks and states of possession. Ancient China and Rome, on the other hand, stressed the contrasting principle of *agon-alea* by focusing on order, hierarchy, and codification of the interaction between merit (which has to be proved in competition) and the accident or "chance" of birth. Games may further be placed on an affective continuum representing evolution from the active, tumultuous, exuberant, and spontaneous, to the calculating, contrived, and subordinated to rules.

The book is divided into "Play and Games: Theme" and "Play and Games: Variation." The five chapters in the first part deal with the definition of play; the

classification, social function, and "corruption" of games; and discuss the derivation of a sociology from games. The second part elaborates, with "An Expanded Theory of Games," "Simulation and Vertigo," "Competition and Chance," and "Revivals in the Modern World." Two appendices deal with the importance of games of chance and psychological-mathematical approaches to games.

Caillois' point of departure is suggested by his comment, "For a long time the study of games has been scarcely more than a history of games." In *Homo Ludens*, Huizinga defends the thesis that culture is derived from play, while Caillois maintains that play derives from culture. The two theses are not contradictory. In the one case, games are viewed as a degradation of adult activities, and in the other, the spirit of play is the source of the conventions that permit the evolution of culture. The contradiction is resolved as follows: "The spirit of play is essential to culture, but games and toys are historically the residues of culture."

Another major theme developed by the author is his contrast of societies based on *mimicry* and *ilinx*, which he terms "dionysian" societies, and societies based on *agon* and *alea*, considered orderly or "rational" societies. Primitive societies are ruled equally by masks and possession. Conversely, "rational" ones are ruled by officers, careers, codes, and fixed and hierarchical privileges, and merit and hereditary position seem to complement each other. In the first type, simulation and vertigo or pantomime and ecstasy assure the intensity and cohesion of social life. In the second type, the social nexus consists of compromise, implied reckoning between the chance of heredity and innate capacity, which can triumph in competition.

As regards merit and chance, it is pointed out that the Greeks had a group of precise concepts of luck *(tyche)*, the portion allotted to each man by destiny *(moira)*, and the opportune moment *(kariros)*, i.e., the occasion inscribed in the immutable and irreversible order of things that is not repeatable because it is part of that order. Therefore birth is compared to a ticket in a universal and compulsory lottery that assigns everyone certain gift privileges.

This is an extremely interesting and important book for understanding the role of games. However, the author is hampered by his lack of appreciation of the role of games as training devices (e.g., tournaments), as teaching devices, and as operational devices. He also fails to appreciate the strategic aspects of games involving a mixture of skill and chance.

Cho-Yo, *Japanese Chess, The Science and Art of War or Struggle, Philosophically Treated* (New York: The Press Club of Chicago, 1905, limited edition, 999 copies printed).

This is a philosophical treatise written in 1905 by a Japanese scholar and admirer of the United States to explain the game of Japanese chess and to discuss it as a war game, using the Russo-Japanese War and Alexander's siege and destruction of Tyre as examples.

The book begins with the author's pen sketch of two trees labeled "A view of comparatively assumed probabilities of relation of branches of chessologics and mathematics as much referred in this work." The style is, to say the least, flowery. However, amid the dense foliage of quotations from Huxley, Dickens, Tom Paine,

Kazan, Napoleon, Aristotle, Thackeray, Holmes, Banzo, Fielding, St. Augustine, and Russian references to "yellow-rats," there are some worthwhile original observations. Notable is a warning to kibitzers that might well be taken seriously:

> The author, when a mere boy, watching his grandfather playing *IGO* was told once a while by his mother that he should not disturb the welfare of the players; and she referred to the square pit on the back of the chess board and *IGO* board. She stated that when bystanders would make trouble or lead rough conducts around players, or say or remark or suggest about plans or take the side of one, or when one player would have acted any mean unmanly unchivalrous campaign on the stage of struggles, the player himself so provoked could punish the impolite, unresponsible fellows by killing the offender on the spot and by putting his head chopped off on the back pit turned upside down. The mother said that it was for the purpose to have the hollow part, and that the killed deserved to have been punished because of a violation of strict, fundamental laws, and ethical rules of etiquette of the *Samraism*, the first principle of the then governing class of people. (p. 27)

This book contains the earliest reference to the possibility of business gaming that the reviewers have encountered:

> Being purely abstract, Chess when represented as concrete, depending upon the different mental attitudes of persons, would, therefore, stand as a business game for a business man, as a military game (as already schemed as a war game, suggested by the chessological principles) for an army man, as a naval game for a navy man, as shown by a Japanese battleship commander who played a live Japanese chess game by substituting the subordinate officers for the pieces of the game board chalk-marked on the deck of the ship involved in the present war, as a real and true war game for a war man, man of warfare, as a philosophical solution for a deep thinker or a speculator, as a love game for all persons concerned in the affair, as politics for a politician, or a statesman, a diplomatic game for diplomats, its application upon international law to settle international struggles.
>
> The Japanese experts say that they can discern generally the characters of persons in playing the game of Chess more than anything else. Indeed, by Chess, certain persons' characters in general forms, whether business or military men, or what not, can be fairly ascertainable. (p. 27)

For reasons that are unclear, the author dislikes games with draws. He discusses at length the fact that draws, while common in occidental chess, are virtually nonexistent in Japanese chess *(shogi)*. In his description of the 9-by-9-squared Japanese chessboard and pieces, he elaborates on the various analogies one can draw between arrangements of the pieces and military organizations. He stresses the greater abstraction of Japanese chess over occidental chess, noting that Japanese chess pieces all have the same shape and are thought of as being composed of aggregates. He advises against calling the Japanese chess pieces "men," preferring the word *koma* or "piece" as a better abstraction.

This does not serve as a concise instruction manual for learning to play Japanese chess. Several pages of philosophical exposition precede the description of the moves of any piece. But the book has value for historians of games and also as a cultural document. Near its end, in a brief description of Chinese chess, the author observes, "Chess is much played by literary men as well as women—usually for small stakes, as the Chinese are born betters, while the Japanese, on the contrary

generally hate to bet, but they are delighted to wage a victory by displaying beautiful skill merely for skill's sake."

T. A. Cowan, *The Game of Science* (Santa Monica: The Rand Corporation, P-3182, July 1965).

The author describes his intentions so well that his introduction deserves extended quotation.

> The following is an attempt to create the conditions for the development of an aesthetic for science. The heavy weight of morality threatens to make the scientist over-weary and to take the savor from his work. There is no great gain in this constant, almost neurotic insistence that the scientist accept responsibility for the moral shambles which is our modern world. Besides, it may well be that what the scientist needs most to make him more moral (if indeed he *should* be) is a more interesting and more vital aesthetic. Philosophy has long abandoned the scientist to his own devices, except in certain severely specialist areas such as logic and quantum mechanics. On the other hand, the philosophers have retained for themselves the existentialist aesthetics, never caring whether any such things as existentialist science ever will or can come into being.
>
> I have not tried to lay the foundation for an existentialist aesthetic for science in these notes. Rather, I have simply set forth the skeleton of a generalized aesthetic, hoping that cultural conditions may now be ripe for covering the skeleton with flesh and bones. I put forth the following ideas in the expectation not that they will guide but that they will at least stimulate the thought of others and that so stimulated something like the game of science as here outlined will get underway. (p. v)

This is a stimulating, offbeat short paper by an individualistic and controversial person. It comes as a welcome relief to those of us buried under irrelevant demands for misperceived and transitory "social significance" for any professional act.

In the Appendix, the author's "game of science" is described; its structure, rules, and postulates are specified; and examples of simple and complex games are given. A simple game, for example, would be to write a computer program for a series of abstract paintings or to show how a given business firm could be driven into bankruptcy by: maximizing profits, minimizing costs, adopting a rational inventory policy, hiring experienced personnel, increasing sales, cutting production costs, reducing competition, or all of these. Examples of complex games are (1) design a utopia to replace the city of Los Angeles, and (2) try the inventor of an "annihilation bomb" before a World Court specially designed for that purpose.

Though most of the author's points and assumptions are disputable, the essay as a whole is exhilarating. It prompts the busy professional to stop and ponder the meaning of "relevance" and "responsibility" in scientific work.

Morton D. Davis, *Game Theory: A Nontechnical Introduction* (New York: Basic Books, 1970).

This is an excellent, up-to-date, nontechnical introduction to the theory of games. Its six chapters cover one-person games, two-person zero-sum games, utility theory, two-person non-zero-sum games, and a general discussion of n-person game theory. It is well written and gives many simple examples and a brief discussion of experimental evidence for different types of behavior predicted in various game structures.

Especially useful for the reader who knows little mathematics or game theory, this book requires no mathematical sophistication beyond the ability to understand a 2-by-2 payoff matrix. The few diagrams are presented with great care and clarity. Excellent as a primer on game theory, it will not serve the needs of those who are more sophisticated, who are curious about the limitations of game theory, and who desire a critique instead of an exposition. Nevertheless, it is probably worth reading by even the professional for its clarity and readability. It also contains a concise, well-chosen bibliography.

Melvin Dresher, *Games of Strategy: Theory and Applications* (Englewood Cliffs, N.J.: Prentice-Hall, 1961).

This is a fine study of the application of two-person, zero-sum game theory covering tactical games and problems of timing, duels, and allocation. The applications are especially pertinent to tactical air war and many other military activities.

The excellent contents would have been better served by less misleading packaging. The title, for example, might more aptly have been *Two-Person, Constant-Sum Games: Theory and Applications.* Contrary to the jacket blurb, which extols the book's utility for the behavioral sciences, economics, and political science, the work is only for the professional who is interested in the mathematics of two-person, constant-sum games and their applications.

Beginning with the description of a two-person, zero-sum game of strategy, the discussion moves to a proof of the minimax theorem; definition and examination of optimal strategies in a two-person, constant-sum game; and description of other forms of games of strategy and methods for solving them.

In Chapter 6, games with an infinite number of strategies are defined. An example is a duel where an individual can fire at any time. Solutions for these games are developed, and the different types of duels are carefully analyzed. There are, for example, noisy duels, in which the duelist can hear the fire of the other side and thus can estimate how many bullets are left; silent duels; and noisy-silent duels, in which one side is silent while the other side is noisy.

The chapter devoted to the formulation of a tactical air war game is important to the war gamer because it demonstrates both the analytical power of game theory and the limitations in scope of model-building for analytical games.

Environmetrics, Inc., *The State-of-the-Art in Urban Gaming Models* (Washington, D.C.: U.S. Department of Transportation, July 1971).

Compiled at the request of the Secretary for the Environment and Urban Systems, Department of Transportation, this work surveys about 20 urban games, including manual grid board games, non-grid manual games, computer-based gaming models, and gaming models in general. Appendices include a bibliography of 125 items; "Citizen Participation Exercises" using models; some rudimentary modeling techniques; and a list of persons active in urban gaming.

In reading this account, one is struck by the lack of precision in the stated purposes and goals of these games. They do not seem intended to aid research or to apply to public policy. Education and training appear to be the operating rationale. One might even suspect that entertainment purposes predominate, given the scant evidence of testing just what players have learned from the games and the lack of concern for whether games are the most cost-effective way to accomplish what more conventional techniques can do. Games *are* fun to build and to play.

As a discussion of the state-of-the-art, this report is disappointingly thin in several critical regards, though the meagerness probably reflects the youth of this branch of gaming (viable only since 1965) and the haste of the report's preparation (one month was allowed) rather than inadequate treatment per se. To be more specific, except for the remark that the METRO-APEX series of games has cost over a million dollars and that over two million has been spent on CITY I and the CITY MODEL family, cost is not considered. Cost is a critical issue and demands professional attention. The importance of the director's role and the scenario of a game appears to have been ignored, though it is becoming clear to the gaming profession that they have much to do with a game's play, outcome, and effectiveness. Validation is not mentioned; the reader is not told what steps have been taken to establish professional criteria and how they have been applied to the existing inventory of urban models and games. One suspects that this subject has been given insufficient attention. It is important, because a careful evaluation of models at an early stage might save great sums of money that would otherwise be spent on their development and expansion. Judging from the bibliography, documentation of activity in urban gaming has not passed much beyond the descriptive and self-congratulatory stage. This is a serious problem, as is suggested by the following comments from a German scholar who attempted to transfer and use several of the games that were described:

> The past development [of urban gaming] has been considerably handicapped by an insufficient communication between the engaged: there have been only a few publications; information on further activities could be gained in most cases but by chance. Due to the lack of an appropriate communication device this situation has intensified the isolation of projects as well as the low level of general acceptance and support.*

In view of the youth of this branch of gaming, the foregoing criticisms may be too harsh. But they are fully justified as responses to the following inflated expectations expressed in the report:

> The new evolutions continue to create useful educational and training devices, but several of the developers and builders are hopeful of developing useful policy tools. (p. 74),

and,

> The state-of-the-art of urban gaming should change dramatically over the next several years as these two models [METRO-APEX and CITY MODEL] have wider impact, and as many of the other urban models gain wider exposure. (p. 76)

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* Henning Schrap, "Urban Systems Gaming—Development in Germany," Paper presented at the Second International Gaming and Simulation Conference, Utrecht, Holland, July 1-4, 1971, p. 14.

Edward Falkener, *Games Ancient and Oriental and How To Play Them* (New York: Dover Publications, 1961).

This is a classic on the history of games, first published in 1892. It describes the games of the ancient Egyptians: *Tau, Senat, Han,* and *Atep,* the last of which survives as an Italian game called *Mora.* Several chapters examine chess, beginning with *Chaturanga* and proceeding through Chinese, Japanese, Burmese, Siamese, and Turkish chess. Draughts (or checkers), including Polish and Turkish draughts, is discussed. *Go,* or *Wei-K'i,* is described. Four chapters are devoted to backgammon; Parcheesi is touched on. The last part of the book takes up magic squares and knight's tours.

In the discussion of Indian and Chinese chess, it is noted that *Chaturanga* was originally played by four sides, each with eight pieces, two of the sides being allied. Moves depended upon a chance device. The name for Chinese chess translates to "Game of the Science of War." Not only are the pieces called elephants, infantry, and war chariots, but also the king or leading general stays with his counselors in a fortress. A river separates the two territories. Furthermore, a key piece to the game is the cannon, which fires over other pieces. Thus it appears that Chinese chess is far closer to a war game than is Indian chess. Falkener estimates the date of invention of Chinese chess at 200-300 B.C.

Concerning Japanese chess, or *Shio-ghi,* Falkener comments: "Shio-ghi is played chiefly by the intellectual classes; Go is a popular game and Sugorochu or 6-6, a game of chance, is the favorite of the lower orders." In Japanese chess, prisoners may be played again by their capturer. Furthermore, they change in power depending upon where they are reintroduced.

This book makes enjoyable reading for the buff, although for many of the games, such as backgammon and *Go,* the description is skimpy. Nevertheless it does present a good overview, and for those concerned with the structure of games the slight differences in rules among the national varieties of the same game are of interest.

Jay W. Forrester, *World Dynamics* (Cambridge, Mass.: Wright-Allen Press, 1971).

The one significant contribution of this book is "[a] glimpse [of] the nature of multi-loop, non-linear feedback systems, a class to which all our social systems

belong. The book has shown how these systems can mislead us because our intuition and judgment have been formed to expect behavior different from that actually possessed by such systems." (p. 123) In all other respects, this book constitutes advocacy for large-scale, unsubstantiated model-building. Its behavioral scientific content is virtually nil. Its engineering scientific content presents nothing new. Its observations on political processes are commonplace, and it does not shed light on bureaucratic processes. Empirical content is nonexistent.

On the positive side, the author's DYNAMO language is an easy computer language that is intuitively attractive and has good input/output features. Forrester and his colleagues appear to be willing to model anything, and they have elsewhere criticized econometricians for being afraid to try to model anything they cannot measure with accuracy. That challenge is probably healthy for all concerned. Admittedly, Forrester's dynamic models are no worse than most mathematical economic models of growth, but designers of the latter are modest enough not to overinflate the significance of their simple constructions.

Works such as this are useful in showing how the understanding of human affairs can be approached in an imaginative, simplistic, and superficially attractive but unsound way.

R. Buckminster Fuller, "The World Game," 1969-1970.*

This is a potpourri of pitchmanship for an ill-conceived computer-based game to be established at Southern Illinois University at a cost of $16 million. The author told a Senate subcommittee, "It will be so photogenic that it will become popularly and repeatedly broadcast on the world TV circuits."†

Reports on the World Game consist of misstatements of fact and theory on game theory and the current state of gaming and simulation. The following quotation illustrates the flavor of Fuller's pitch and the extent of his misunderstanding. It is taken from his testimony in 1969 before the Senate Subcommittee on Intergovernmental Relations.

> . . . the theory of John von Neumann's war gaming, which holds that ultimately one side or the other must die, either by war or starvation, is invalid.‡

Von Neumann and Morgenstern were never so naive as to believe that the world is a finite, two-person, zero-sum game. The von Neumann-Morgenstern efforts aimed at providing a respectable, scientific underpinning to game theory. Fuller has not only misunderstood their minimax theorem and their other critical (albeit elementary) contributions, but he has also failed to make the proper connection between the highly abstract and necessarily simplified elements of a two-person, zero-sum game and anything in the real world.

Thus we are prepared for the oversimplification in Fuller's following comment:

> I propose that . . . a great world logistics game be played by introducing into the computers all the known inventory and whereabouts of the various metaphysical and physical resources of the Earth. This inventory, which has taken forty years to develop to high perfection is now housed at my Southern Illinois University headquarters.**

To this plan a well-intentioned Congressman from Illinois, Melvin Price, proposed that public funds be committed (H.R. 17467, May 21, 1970), and the State of Illinois actually offered matching funds to $4 million.

Serious gamers have strong reservations about the possibility and utility of constructing large-scale models to attack some of the critical problems of our society. Gaming projects marked by indifference to professional efforts, yet attaining wide publicity, retard real progress in the field.

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* Various related published items, including Fuller, "The World Game," *Ekistics*, October 1969; accounts of Fuller's Jawaharlal Nehru Memorial Lecture, November 13, 1969, carried in various Indian newspapers; "Today Greenwich Village, Tomorrow the World," *THINK* (IBM magazine), November-December 1969; Fred Warshofsky, "Meet Bucky Fuller, Ambassador From Tomorrow," *Reader's Digest*, November 1969; Harold Taylor, "Inside Buckminster Fuller's Universe," *Saturday Review*, May 2, 1970; and *Buckminster Fuller Presentations to Congress: The World Game*, Carbondale, Illinois, Southern Illinois Univ., 1970, mimeo. (hereafter cited as *Presentations*).

† *Presentations*, p. 3.

‡ Ibid., p. 2.

** Ibid., p. 9.

Sidney F. Giffen, *The Crisis Game: Simulating International Conflict* (New York: Doubleday, 1965).

This is a mediocre book consisting of one part autobiographical recollection, one part badly written history of gaming, and one part genuine insight into the purpose and utility of scenarios and scenario writing. It is the latter component to which we devote major attention.

Recasting the 1962 Cuban Missile Crisis in game scenario format is a highly useful exercise, the point of which, coming as it does after the disorganized, 86-page summary of gaming history, is nearly lost. No one would have *a priori* believed the sequence of events known as the Cuban Missile Crisis had it been played as a game. What is left unsaid is that if gaming is to be a creative, thought-provoking activity, such marginally plausible sequences ought routinely to be systematically explored.

Crisis gaming, as currently executed and as described by Giffen, fails to reiterate a given scenario enough times to begin such explorations. Typically, players make a one-shot pass through a scenario, taking the most likely or most plausible choices. Alternative sequences, if discussed at all, are summarily dispatched in post-game critiques. This is unfortunate but explicable as a problem rooted in a misperception of gaming as a predictive rather than a stimulative activity.

The idea of summarizing history explicitly in an efficient scenario format has some utility for both serious gamers and transmitters of history.

S. Groennings, E. W. Kelley, and Michael Leiserson, eds., *The Study of Coalition Behavior: Theoretical Perspectives and Cases from Four Continents* (New York: Holt, Rinehart & Winston, 1970).

This collection of 25 essays consists of empirical cases complemented by a series of chapters dealing with the theoretical and methodological aspects of coalition-formation.

The case studies are mercifully jargon-free. For some, they may not be sufficiently integrated into a theoretical framework; on the other hand, given the complexity of the subject, that may not be a shortcoming. The second part should interest political scientists and gamers in several ways. The impact of game theory on gaming is a noteworthy theme; virtually every article mentions both those subjects. Also evident is the need to develop dynamic theories to account for the sociopsychological and sociopolitical problems being considered.

The divergence between game theory and gaming results shows that the gap is large between the primarily static theorizing of the former and the dynamic phenomena encountered in the latter. William Riker and a few others have tried to extend static game theory to encompass the dynamics of coalition behavior, but they have not been entirely successful. We just do not have as yet the mathematical, empirical, or social-science bases on which to produce formal dynamic models whose properties can be studied analytically and whose predictions can be tested empirically. This is not meant as a criticism of the book. The problem is fundamental and extremely complicated; it does not admit of a quick and easy solution.

It is hoped that works such as this will stimulate the development of detailed dynamic models of coalition behavior. It is probably premature, given our stage of knowledge about processes, to expect satisfactory theories of coalition-formation to be developed before the detailed preparatory work has been done. This book is a step in the right direction.

Harold Guetzkow, "Simulation in the Consolidation and Utilization of Knowledge about International Relations," in D. G. Pruitt and R. C. Snyder, eds., *Theory and Research on the Causes of War* (Englewood Cliffs, N.J.: Prentice-Hall, 1969), pp. 284-300.

This essay explores the potential utility of simulations as devices for ordering theories and integrating empirical findings. It concludes that simulations can be a useful complement to the application of verbal and mathematical theories in systematic analysis. It proposes that the analysis of international relations be expedited by the establishment of colloquia whose main work would be simulation, to promote a continuous dialogue between theory-builders, empirical researchers, and policy developers.

> Perhaps the time is now appropriate for a more integrative, long-range effort than is possible alone through doctoral dissertations, textbooks, collections of juxtaposed readings, handbooks of summary pieces, substantive inventories developed for special occasions, and *ad hoc* conferences and committee reports. Given the pace of the explosion of knowledge within the international relations area which the foregoing efforts are yielding, it seems imperative that a technique of potential efficacy be explored to hasten a tighter, more cumulative articulation of this knowledge. . . .
>
> These are the goals, then: to develop simulation theory in the context of verbal speculation and mathematical constructions about the structures and processes involved in international affairs; to apply a variety of criteria

> in the validation of such theory, depending upon the purposes for which it is intended; to use for decisionmaking the knowledge which has been consolidated for purposes of policy development, both in terms of short-run box scoring and in the long run for the creation of alternative futures. If such is the potential the query becomes "how can we accelerate our rate of accomplishment in achieving these goals?"

The reviewers are in complete accord with Professor Guetzkow's vision. The use of simulation is indeed promising as a data-organizing device, as a means of establishing communication between people who have completely different world-views and roles to play in society, and for many other purposes. Moreover, the format of a simulation enables one to teach model-building and abstract thinking to people who are utterly unaccustomed to the construction of formal models.

Overall, however, the study is a mixture of good and bad. Its valuable insights are combined with a deep and dangerous lack of perception of the difficulties of implementing what is advocated. The style is forceful, but critical evaluation of the subject is virtually absent. In particular, there is a great gap between vision and implementation. Those who have worked in large-scale gaming and simulation have become cautious about it. It is all too easy to waste millions of dollars in ill-conceived or premature simulation and gaming. It is even easier for academics to totally misestimate the administrative needs and difficulties in coordinating work among decisionmakers, administrators, planners, researchers, and university teachers. The difference between what a computer system will really do for you and what is usually promised by your hardware consultant is enormous. The worth of a large-scale game or simulation depends on the quality of the human work, not so much on the quality of the hardware.

Many gamers cherish the vision of a brave new world of integrated, computerized systems. However, more than charismatic leadership is called for at this stage. This stimulating article would have been far more useful had it given attention to the quality of the work performed to date.

Guetzkow appends a full list of references, but they range from extremely good to extremely bad work, and the reader is given no indication of their relative merits. For example, as regards the Inter-Nation Simulation, there are serious questions whether, for the same expenditure of personnel and money, far better results might not have been achieved by developing, say, very small simulations or mathematical theory, or by writing better histories. In his observations on Brody's work on the "Nth Country Problem," Guetzkow refers to the consequences of the spread of nuclear weapon technology among nations. Regardless of the quality of Brody's work, what it proved and whether or not his conclusion could have been demonstrated better with a simple mathematical model are open to question.

The program that Professor Guetzkow calls for may be precisely what is needed now. Regrettably, however, the program contains no indication of feasibility, costs, quality, difficulty of implementation, alternative approaches, or measures of performance. This may be too much to ask of a brief proposal. Nevertheless, in view of the history of great white elephants in this area, it is vital that a person of Professor Guetzkow's stature sufficiently substantiate and document his proposals, so as to temper our enthusiasm for new leviathans.

Harold Guetzkow et al., *Simulation in International Relations: Developments for Research and Teaching* (Englewood Cliffs, N.J.: Prentice-Hall, 1963).

Simulation in International Relations and the brainchild it launched, the Inter-Nation Simulation (INS), have been important for the study of international relations and for the educational use of gaming and simulation. When it was written it appeared likely that INS could give some system and rigor to the desultory field of international relations. A significant number of undergraduates depended heavily on INS to teach them about international relations, and a significant number of graduate students were trained with it. Fundamental portions of INS have been revised, updated, made more machine-dependent, and are now being used for educational purposes by the Industrial College of the Armed Forces, among others.

This book suffers from the familiar defects of a compilation: the quality and purposes of the parts are so diverse as to make an overall assessment both difficult and somewhat meaningless. Consequently, this review restricts itself to a summary characterization and assessment of each author's contribution.

Richard Snyder, "Some Perspectives on the Use of Experimental Techniques in the Study of International Relations," surveys trends in simulation and gaming and lists the pertinent literature up to 1962. Among the useful points that Snyder makes are the following: (1) Researchers often confuse a laboratory experiment or simulation with the real-world context it is meant to portray. Uncritical generalizations occur as a result. (2) Simulation may be more useful for investigation than for testing or validation. The rigorous, scientific aspects of man-machine gaming are demonstrably few. (3) Motivation is important in game play and it significantly affects learning, but little is known about why and under what circumstances it is important (for example, about what happens in a game when motivational stimuli are systematically varied).

Harold Guetzkow, "A Use of Simulation in the Study of Inter-Nation Relations," briefly recounts the history of INS. In presenting the case for and against the use of "neutral," or context-free, role assignments for gamers, he contrasts INS's use of neutral roles with the country-specific style used in the Rand/Goldhamer political-military games.

Robert Noel, "Inter-Nation Simulation Participants' Manual," and "Evolution of the Inter-Nation Simulation," gives a thorough description of INS, including player roles, events, sequencing, and forms. There is not enough documentation, however, to permit an otherwise uninitiated reader to run INS. Noel also recounts two early runs of the simulation: the first used college students and the second used ex-foreign service and academic personnel. Besides demonstrating the feasibility of the simulation, they showed that the more sophisticated players demanded greater elaboration—a richer information environment—to play the game. That raises the important issue of how the attributes of the gamers affect the play and outcomes of a game. But not much light is shed on it.

Noel acknowledges that intuition and hunch played an important part in the development of INS and that "the evolution of the simulation . . . is an empiricism of the rawest kind, typical of prescientific activity." (pp. 101-102)

Guetzkow, "Structured Programs and Their Relation to Free Activity Within the Inter-Nation Simulation," describes the theoretical underpinnings of INS:

> Although no explicit reference has been made to the scholarly literature of international relations, the constructors of this operating model have steeped themselves in this body of speculation. . . . Perhaps more attention should have been devoted within the chapter to justification of our decisions, indicating the rationale employed in making each of the individual choices. As yet, no formalized criteria have emerged to provide guidance for our exploitations of the work of others. . . . It is important that a firmer embedding of our model within the studies of international relations be attempted, so that an almost total reliance upon an intuitive grasp of this literature may be circumvented. (p. 147)

It is not clear whether the admitted scientific weaknesses of INS are the model-builder's responsibility or are more properly attributed to "this body of speculation" (international relations theory). It matters little, for the difficult and expensive tasks of developing and validating INS's theoretical structure still have not been carried out.

As described by two of its principal designers, Guetzkow and Noel, INS is little more than a hardened and formalized, albeit imaginative, testimony to our general scientific ignorance about international relations. That being so, one should have grave reservations about using INS for any practical purposes.

Chadwick Alger, in "Use of the Inter-Nation Simulation in Undergraduate Teaching," expresses few such reservations. On the contrary, he claims that INS provides educators with a miniature world that increases students' interest so much that they learn more about international processes. Having been previously informed of the "prescientific" and "speculative" basis of INS, the reader is disquieted to see, "In order to participate in the simulation, the student must learn this model . . . his success as an official in one of the simulated nations depends on his learning the relationships among variables in the simulation" (p. 162). One must be careful not to misteach when using games for educational purposes.

After taking the reader through a hypothetical run of INS, Alger reproduces several statements by students attesting to their increased personal involvement, motivation, and interest through INS. Nothing is presented to show what the students actually learned from playing it. Nothing is said about alternative methods to achieve similar educational objectives. Nothing is mentioned about the cost of training people with INS versus conventional methods; for that matter, nowhere in the entire book is there an accounting of what the Inter-Nation Simulation cost to build or to operate.

"Varieties of Simulations in International Relations Research," by Richard Brody, catalogues several of the more prominent political-diplomatic-military games and simulations. They include the works of Herbert Goldhamer (Rand-Crisis and other free-form games), Oliver Benson (Simple Diplomatic Game), Charles McClelland (World Politics Game), Lincoln Bloomfield (Political Military Exercise), Arthur Burns (board games), and Thomas Schelling (simple matrix games). A useful, selective bibliography is appended.

Simulation in International Relations represents a milestone in the fields of international relations and educational gaming. It is high time for a thorough and honest stocktaking of the entire INS enterprise, and this book provides a wealth of source material by which to do it.

Harold Guetzkow, ed., *Simulation in Social Science: Readings* (Englewood Cliffs, N.J.: Prentice-Hall, 1962).

Guetzkow's reader has had considerable influence on the teaching and development of simulation methodology, and with good reason. This book is a judicious choice of articles that discuss the development of simulation as a tool in various disciplines: psychology, sociology, political science, economics and business, education, industrial engineering and operations research, and military operations. The contributors, uniformly distinguished, include Robert Abelson, James Coleman, Carl Hovland, John Kennedy, Guy Orcutt, and Ithiel de Sola Pool. To list the cited applications of simulation is to enumerate some classic achievements. Flight simulators, small-group problem-solving under stress, the Inter-Nation Simulation, the Carnegie Tech management game, the in-basket exercise, the New York Port Authority bus terminal analysis, and the Systems Research Laboratory are all discussed concisely and knowledgeably by those primarily responsible for their creation and development.

The only flaw for the current-day reader is the age of the book. Much of its material has been superseded, and the volume itself is rather difficult to obtain. However, for describing the state of simulation and its uses in the early 1960s, there is probably no better text around. Footnotes are ample, and the bibliography is selective and of high and durable quality.

J. Haldi and H. M. Wagner, *Simulated Economic Models* (Homewood, Ill.: R. D. Irwin, 1963).

This book attempts to apply gaming to the teaching of microeconomic theory. Geared to liberal-arts, business, and engineering students, it presents a series of six laboratory exercises designed to teach certain economic principles. It is a noncomputer game. The exercises stress the utility of economic theory applied to a variety of complex, realistic problems; they also show how dynamic forces guide competitors and demonstrate the roles of uncertainty and risk.

Each laboratory session runs two to three hours. The time is divided into preparation, simulating one of three prescribed model economies, collecting material and comparing results, assigning graphical and numerical analysis exercises, and answering discussion questions. The miniature economy, for example, has two industries, manufacturing and retail, each of which in turn contains two competing firms. The administrator plays the household sector of the economy.

This is a first-class effort at designing a serious game for teaching. The structure is simple, the game is easy for the administrator to control, and there is rapid feedback in the form of immediate tests for comprehension. The length of the sessions is appropriate. The authors used the game for several years, with considerable success, before publishing the final version. It seems strange, then, that it is not in wider use today. Unlike many other games, the theory it illustrates is reasonably well accepted by practitioners in economics. Its success in the hands of the authors may owe to their unique motivation and skill. Its apparent lack of success with others may point up the importance of devising procedures to inform and motivate others to use successful games.

Richard C. Henshaw, Jr., and James R. Jackson, *The Executive Game* (Homewood, Ill.: R. D. Irwin, 1966).

The Executive Game is a direct descendant of the UCLA Executive Game #2, one of the best-known and most widely used business teaching games. This book has undergone ten separate printings, four of them in 1969 alone.

The distinction of the book, and of the UCLA project in general, is the thoroughness of the documentation. With this one publication, the game can be set up, run, and used for teaching purposes by one with only moderate technical qualifications. In other words the game is easily transferable and widely usable.

Here the game is presented in three forms: a player's manual; the underlying mathematical models and game flow charts; and a reproduction of the computer program supporting the game. Each is marked by clear, step-by-step exposition.

Strategic variables in the game include price, marketing expenditures, research and development, maintenance, production volume, capital investment, purchase of raw materials, and the setting of dividends. Outcomes, presented in chart and tabular form at the conclusion of the computer runs, include competitor status, sales volume of each hypothetical firm, percentage of the market, production for the quarter, finished goods inventory, plant capacity expected in the next quarter, income, cash flow, and a balance sheet. Outputs are all in formats that are easily understood and more-or-less standardized according to accepted business practices.

Having noted some of the game's excellent features, we should comment on several of its weaknesses. As the authors acknowledge, "The Game Administrator's imagination and skill in utilizing The Executive Game primarily determines the degree of success that may be achieved." (p. 83) The importance of the game controller is critical in a game that can be transferred and used as easily as this one can. Misapplication and misteaching may well be the outcomes where the quality of the people controlling the game is uneven or low. Control for the Executive Game consists mainly of setting parameter values for the elasticity of certain embedded functions and of assigning initial conditions for each of the competing firms. But the game can play quite differently with only marginal modifications in several of the parameters, so setting those values is by no means a trivial matter.

Judgment seems to substitute for firm theoretical support in many of the game's behavioral equations. The game supplies answers, in the form of hard equations, for questions that are in fact still under debate: Does marketing (advertising) really make a difference in performance? How much? Under what circumstances?

The Executive Game's potential for experimental use has been largely untapped. Though it has been run countless times in the course of its development, the game has missed the opportunity to study such experimental questions as, How do different stakes affect game play? and, How does the competence of the players affect game play?

A final weakness is the lack of any clear statement of what the game is intended to accomplish and how much better it achieves its ends than more conventional techniques.

Herman Hesse, *Magister Ludi [The Glass Bead Game,]* Richard and Clara Winston, trans. (New York: Holt, Rinehart & Winston, 1969).

This is the eminent philosophical novel that figured importantly in the author's receiving the Nobel Prize in 1946. In this review we consider its contribution to our understanding of the role of games in human affairs. The novel's value to the user of games lies in its deep and perceptive discussion of the conflict between epistemologies that are abstract and "out of context with the rest of the world" (as are games) and approaches to understanding via historical and more humanistic methods.

In the foreword to this English edition, Theodore Ziolkowski observes that Hesse's "Glass Bead Game is an act of mental synthesis through which the spiritual values of all ages are perceived as simultaneously present and vitally alive." (p. ix)

Hesse himself says, on the nature of the game,

> These rules, the sign language and grammar of the Game, constitute a kind of highly developed secret language drawing upon several sciences and arts, but especially mathematics and music (and/or musicology), and capable of expressing and establishing interrelationships between the content and conclusions of nearly all scholarly disciplines. The Glass Bead Game is thus a mode of playing with the total content and values of our culture; it plays with them as, say, in the great age of the arts a painter might have played with the colors on his palette. All the insights, noble thoughts, and works of art that the human race had produced in its creative eras, all that subsequent periods of scholarly study have reduced the concepts and converted into intellectual property—on all this immense body of intellectual values the Glass Bead Game player plays like the organist on an organ. (p. 6)

Those remarks may be regarded as a plea for a "world game" or a "great simulation in the sky"—as if the essence of everything is to be abstracted for easy manipulation by an intellectual elite. One of the characters in the book, Father Jacobus (based on the historian Jakob Burckhardt), says,

> You mathematicians and Glass Bead Game players have distilled a kind of world history to suit your own tastes. It consists of nothing but the history of ideas and of art. Your history is bloodless and lacking in reality. You know all about the decay of Latin syntax in the second or third centuries and don't know a thing about Alexander or Caesar or Jesus Christ. You treat world history as a mathematician does mathematics, in which nothing but laws and formulas exist, no reality, no good and evil, no time, no yesterday, no tomorrow, nothing but an eternal, shallow mathematical present.
>
> You are great scholars and aesthetes, . . . you measure the weight of the vowels in an old poem and relate the resulting formula to that of a planet's orbit. That is delightful, but it is a game. And indeed your supreme mystery and symbol, the Glass Bead Game, is also a game. I grant that you try to exalt this game into something akin to a sacrament, or at least for a device for edification. But sacraments do not spring from such endeavors. The game remains a game. (p. 169)

In discussing the role of game-playing and its relationship to ruling, the Magister Ludi observes,

> We . . . are not suited for ruling for all that we are civilized and highly intelligent people. If we had to govern we would not do it with the force and

> naïveté that the genuine ruler needs. Moreover, our proper field and real concern, cultivation of an exemplary cultural life, would be quickly neglected. Ruling does not require qualities of stupidity and coarseness, as conceited intellectuals sometimes think. But it does require whole hearted delight in extroverted activities, a bent for identifying oneself with outward goals, and of course also a certain swiftness and lack of scruples about the choice of ways to attain success. And these are traits that a scholar—for we do not wish to call ourselves sages—may not have and does not have, because for us contemplation is more important than action, and in the choice of ways to obtain our goals we have learned to be as scrupulous and wary as is humanly possible. (p. 330)

Games are abstractions, and nearly everyone likes to play them. There is undoubtedly a universal game and play element in human culture. In this day of planned programmed budgeting, cost-effectiveness, and large-system models, it is easy and tempting to construct nonhistorical, out-of-context methods of analysis under the guise of providing an interface between science and policy, obscuring the sterility, irrelevance, and arrogance of such an undertaking. This novel sounds an eloquent cautionary note against it.

Johan Huizinga, *Homo Ludens, A Study of the Play-Element in Culture* (Boston: Beacon Press, 1950).

This book, written in 1938 by an important historian of culture, is regarded by many as a classic. It is an exposition of the role of the the instinct of play in law, war, poetry, philosophy, art, and other aspects of civilization.

The discussion opens on the nature and significance of play as a cultural phenomenon. It continues with an investigation of the play concept as expressed in language; play and contests as civilizing activities; play and law, play and war, etc. At the end, the roles of play and games in Western civilization and in contemporary civilization are considered.

The nomenclature of games, competition, and play in various languages is enlightening. In Greek and several other languages, for example, there is no linguistic distinction between the ideas of contest and play. A distinction useful for operational games is made regarding attitudes toward play: "Seriousness seeks to exclude play, whereas play can very well include seriousness."

The author betrays a naïveté about science and technology. He also shows little understanding of games and the nature and significance of their play, which is not explainable by the early date of writing. Though game theory had not been formally developed, there was much literature on games for entertainment and war games.

Particular points to which one might take exception are the following. The statement, "Animals play just like men" (p. 1), is ill defined and completely unsupported (as well as tautological). "All play is a voluntary activity" (p. 11) narrows the scope of the application and the meaning of the play element in society considerably. It excludes, for example, all operational games for which players have been recruited, even though most of the attributes of play—order, tension, movement, change, solemnity, rhythm, rapture—are frequently present.

In his discussion of winning, the author's task would have been much easier if

he had been able to distinguish between zero-sum and non-constant-sum games, to define clearly the game under consideration, and to conceive of the game outside of the game. His comments on the stock exchange (p. 52) are another example of technical naïveté.

The reader armed with a healthy skepticism and technical knowledge can gain useful insights from this book. Observations such as, "The lawsuit can be regarded as a game of chance, a contest, or a verbal battle" and "Competitions and esoteric knowledge are deeply rooted in ritual and form" offer a new way of looking at the commonplace. In all, however, the subject matter demanded more rigorous treatment than is embodied in this extended *belles lettres* essay.

Industrial College of the Armed Forces, *World Politics Simulation* (Washington, D.C., February 1969).

This describes in five manuals a modified version of the Inter-Nation Simulation known as World Politics Simulation, Mark 3. It was designed by William D. Coplin for the Foreign Service Institute of the State Department. In this form it is partially automated and runs on a time-sharing system connected to a G.E. 605. It is written in FORTRAN IV.

The objectives of the game are

1. To cope with some of the problems and pressures involved in the making and execution of national policy in the international environment.
2. To contribute to the establishment of national policy goals and objectives.
3. To help translate national goals and objectives into specific courses of action by developing and considering alternative strategies and by attempting to anticipate events.
4. To identify, evaluate, and grapple with some likely international problems that may involve crises and potential conflict.
5. To increase familiarity with the varieties and uses of simulation methods and with the value-limitation and other problems of constructing simulations.

The game has excellent documentation in the various manuals prepared for the players, administration, the computer program, and the briefing.

The game takes five days in all: four and one-half days of play and the remainder for debriefing. The teams are composed of six people, each representing a nation, and one administrative control team. The game is computer-assisted in the sense that people can interrogate the system, and is run in a man-machine mode in the sense that decisions are given to the machine for computation. It is a non-constant-sum game. Although the initial conditions and parameters are nonsymmetric, the actual forms are symmetric.

During the playing of the game, although the names of the six countries are used and a certain amount of background material is supplied, no geographic, bureaucratic, or psychological context is given.

There are 68 types of actions that a nation may take to which the automated policy-influencers will respond. They fall in the general categories of budget, trade

and aid, military force, diplomacy, and international events. Much of the behavior is expressed in numbers consisting primarily of budget figures, military force figures, and a seven-point scale to measure attitudes. When war breaks out, the results of the war depend only on formulae for damage attrition in proportion to force size (with a random component).

Written and verbal communication is permitted. The control team may schedule meetings of up to ten minutes between any number of nations. Intelligence or information may be purchased, but at the same cost to all nations. A newsletter is issued during the periods of play in which a nation may plant items.

The briefing stresses that the national roles are not to be simulated as personalities; for example, if one is playing the United States, the idea is not to simulate President Nixon. The players are encouraged to react with their own attitudes and values to the circumstances generated by the background material, program feedback, and events of the game.

In the post-game analysis and critique the game controller and the members of his control team are responsible for leadership. Each national simulator is given about ten minutes to discuss the goals and objectives established by his team and the policies through which they sought to achieve them. He is expected to note the problems they encountered and to assess their efforts. The controller is to take special notice of:

- any evidence of superpower politics and dominance in the game;
- the problems peculiar to underdeveloped nations and their relations with developed nations;
- the intricate relation between domestic and foreign politics;
- the problems of crisis management and conflict control;
- information problems and time pressures in the conduct of foreign affairs; and
- decisionmaking styles, and conflict between the need to act decisively and the need to maintain flexibility and maximize options.

Some of the national goals that have been elicited are: maintaining national security, staying in office, improving the economy, and influencing the world order.

The serious problem with this game is that it tries to do too much in a realm where adequate knowledge is lacking. It is at the same time too simplistic and too complex. The game is so large that computerization is necessary to manage it, and this permits an enormous amount of implicit theory to be imbedded. For example, the rate of population growth is made to diminish with higher consumption and welfare expenditures. The outcome of wars is decided by fairly simplistic damage-exchange computations. The growth of GNP is determined by a relatively simple economic model linking investment to GNP. None of these is necessarily bad in itself, but the result of stringing unsubstantiated approximations together is a model that is too simplistic in theory and yet too complicated in structural detail to allow one to assess its practical utility.

Thus, this kind of game falls far short of meeting its five objectives. It does not provide a reasonable simulation of the problems and pressures in making and executing national policy in an international environment, nor does it allow identification, evaluation, or grappling with international problems. Moreover, such a

complicated model is not useful in establishing national policy goals and objectives and in translating them into specific courses of action. Free-form gaming could probably accomplish this more realistically.

The game could be useful (in a different way than intended) if it were conducted with a debriefing period as long as or longer than the period of play. Several days of debriefing, in which the players looked at the equations, functional forms, and parameters generating the model, could be enlightening. The participants would learn first-hand about the problem of model-building; the need for meaningful data bases; and the difficulty of establishing such simple assertions as, the rate of population growth declines when GNP and welfare expenditures rise.

Rufus Isaacs, *Differential Games; A Mathematical Theory with Applications to Warfare and Pursuit, Control and Optimization* (New York: John Wiley & Sons, 1965).

This is an important technical book written for the applied mathematician. Though it presupposes considerable mathematical background, Chapter 1, the introduction, can be understood by those with far less technical knowledge. It describes battle games, games with moving craft, pursuit games, dogfights, and firing games. Examples are "the homicidal chauffeur game," a simple pursuit game, and a game involving guarding a target. All of these are forms of two-person zero-sum games.

The section on applications of game theory to warfare requires more technical background than Chapter 1. Two examples are discussed, analyzed, and partially solved. The first is to determine the best allocation of weapons between attrition and attack during a protracted war. The second, "the battle of Bunker Hill," poses the problem of the optimal allocation of firepower when two antagonists are nearing each other.

It is noted that there are three techniques available to study actual problems: discrete matrix games, differential games, and simulation. Matrix games are in general not suitable for studying actual problems; they become too unwieldly too quickly. Differential games are useful but have the major drawback of assuming the existence of complete information. A chapter is devoted to differential games without complete information, but the results are limited.

The author observes that there have been large-scale endeavors to play war games and to simulate large-scale war situations. He suggests that gaming and simulation are complementary approaches to the study of differential games.

Stress is laid on the investigation of special examples and applied mathematics rather than on basic examples and pure mathematical theory. Since the publication of this book, considerable work has been done on the application of control theory to games. Dynamic games have become an extremely popular subject. However, when there is incomplete information, the problem of defining strategy becomes quite difficult, a point generally overlooked and scarcely mentioned by the author.

Douglas E. Knight, H. W. Curtis, and L. J. Fogel, eds., *Cybernetics, Simulation, and Conflict Resolution, Third Annual Symposium of the American Society for Cybernetics* (New York: Spartan Books, 1971).

This is a collection of sixteen papers presented at the Third Annual Conference of the Society for Cybernetics. The Conference had two major themes: (1) campus political activism and violence and the possible use of simulation to study the problem it poses, and (2) international conflict analysis and simulation. The discussions were followed by some prognostications on cybernetics in the 1970s and beyond. The papers range from excellent to pedestrian. The article by I. G. Good, "Some Future Social Repercussions of Computers" is typically excellent, strange, and stimulating.

This work partakes of the standard faults of conference proceedings published with little other purpose than to show that the conference was productive. Unless conference organizers have good cause to publish their proceedings and are willing to invest the effort to prepare them properly, they would serve the profession better by not contributing to the "ignorance explosion," the proliferation of low-quality material that makes it more difficult for the intelligent person to keep well-informed.

Major W. R. Livermore, *The American Kriegsspiel: A Game for Practicing the Art of War Upon a Topographical Map,* 2nd ed. (Boston: W. B. Clarke, 1898).

This is a classic. Originally published in 1879, it is the first book published in the United States on the subject of war gaming. The brief introduction reviews gaming prior to 1898. Since von Reisswitz, it is noted, the war game has assumed three different forms. The first lays down few arbitrary rules and leaves it to the referee to decide when troops are compelled to retire, without regard to the losses they have suffered; the second form is for small fights, on which copious records are kept; and the third and preferred form uses an experienced officer as the referee. Livermore bases his exposition on the second form.

Throughout, emphasis is on planning factors and their use in making calculations. The factors include such details as the different speeds of troops marching on good roads, marching across plowed fields, marching under fire, and operating under other conditions. Figures are to be based on empirical evidence.

It is noted that the widespread attribution of Prussian success in the Franco-Prussian War of 1870 to the use of gaming resulted in the adoption of war gaming by most other armies.

The body of the book is primarily a documented manual. In Chapter 1, on the context of the game, Kriegsspiel is divided into five types:

1. The tactical game representing an engagement in all its details.
2. The grand tactical game representing the general outline of an extensive battle.
3. The strategic game involving movements of armies over an extended area for a period of several days or months.

4. The fortification game representing siege operations.
5. The naval game.

Most of these categories exist today, and some new ones, notably the political-military exercise, have been added. Livermore stresses the tactical game, whose two-map version he advocates running with two maps in the same room separated by a barrier so that the players cannot see the disposition of each other's troops. This precisely is how the game of double-blind chess (also known as Kriegsspiel) is played. Most likely the latter got its name from the former.

Time periods simulated in the tactical game are as short as half a minute. A huge number of parameters are spelled out, including morale, fatigue, terrain conditions, and weather conditions. Many random variables are used. Much hand-computation would be required to run a game like this. Unlike most books describing a specific game, this one is so fully documented that it is simultaneously a player's manual, a referee's manual, and a complete set of operating instructions. With no more than this book one could build Livermore's game.

In modern terminology, the tactical games described are generally two-person, zero-sum games with simultaneous moves, lack of information, and random elements. Though the problem of describing winning and losing conditions is not adequately dealt with, and information is scanty on how to debrief a game, when to stop, and how to measure the results, the conceptualization is so clear that anyone seriously interested in war gaming would profit from making the excursion into history to read this book.

The type of Kriegsspiel outlined by Livermore is the ancestor of many of the board games played today for entertainment by an avid group of thousands of amateur war gamers in the United States. See the hobbyist's periodical, *The General*, regularly published by the game company Avalon Hill, Baltimore.

R. D. Luce and H. Raiffa, *Games and Decisions: Introduction and Critical Survey* (New York: John Wiley & Sons, 1957).

This book is virtually a classic. At the time of publication it was an excellent, comprehensive survey of the theory of games, written to be intelligible to a person with very little formal mathematical training. Developments since then in gaming and in formal game theory, its applications to bargaining, political science, economics, and other disciplines, have somewhat dated the material. Nevertheless, to this day we do not have as comprehensive and clearly written an exposition of the basics of game theory. Though it contains more game theory than most practitioners would probably need to know, it represents a prerequisite level of knowledge for those intending to pursue experimental or operational games. The game-theoretic definitions of formal game rules, payoffs, moves and their timing, information conditions, and outcomes are particularly important. Furthermore, the authors' concept of solution, and their argument that formal game theory fails to encompass aspects of bargaining and interpersonal behavior that behavioral scientists consider critical, identify some key problems for game designers to solve and show the need for a multidisciplinary approach to gaming.

F. J. McHugh, *Fundamentals of War Gaming*, 3rd ed. (Newport, R.I.: U.S. Naval War College, 1966).

This is an excellent, clear introduction to the fundamentals of war gaming. The first chapter discusses simulation, war games, models, war game models; the roles of the war game director, the control group, the players, the spectators; specification of purposes; types, scope, and level of games; their numbers of sides, amount of intelligence, method of evaluation; and basic simulation techniques. The value of war games is discussed, and their limitations and relationship to game theory are noted.

Chapter 2 presents an excellent history of war games. Beginning with chess, it discusses military or war science and the vogue of military mathematics in the latter part of the eighteenth century. A General von der Goltz is quoted to have written, "A true strategist of that epoch did not know how to lead a corporal's guard across a ditch without a table of logarythms."

Early war games, for example those based on the concept of aggregation (one piece representing a group rather than an individual), are described. It is noted that the first strategic war game was conducted in 1838 in Berlin. German war games up to World War II and the work of the Japanese at their Total War Research Institute in the 1940s are examined. It is even suggested that the rigidity and arrogance of the game director responsible for testing a Japanese attack on Midway Island in 1942 showed up in the Japanese conduct of the actual battle. War gaming was done at the U.S. Naval War College in the 1930s, and many of the subsequent naval engagements in the Pacific were in part anticipated. It was also used by the allies in the detailed planning for D-Day.

Chapter 3, dealing with rules, procedures, and data, discusses the conflict situation; what data are required for a game and in what detail; the problems of modeling; the basic game cycle; what constitutes a move; the function of the rules and how they are evolved; the role of umpires; the role of probability; the possibility of using expected value models; the meaning of stochastic models; and how to choose among models. It also deals with the question of what constitutes a win for a game. Generally, only extremely small tactical games define the win condition. It is doubtful whether even they should define it. Umpires have three basic duties: (1) to monitor the action of the players and enforce the rules of the game, (2) to evaluate interactions in accordance with the methods and data prescribed by the rules, and (3) to provide the players with the amounts and kinds of information and intelligence that would be available under similar circumstances in the real world.

Chapter 4, on manual games, discusses their advantages and limitations. Among the latter is the possibility of boredom if the calculations take too long in a manual gaming exercise. It is also difficult to replicate manual games on a large scale, although in 1896, 120 tactical games were played at the Naval War College to evaluate the effects of superior speed. Such a game today would undoubtedly be computerized.

Some games are described in good detail. Naval War College board games, a submarine tactical game, the use of hexagonal grid systems, Naval War College chart games, Naval command-course manual games, the JCS political-military desk games, Tacspiel, Monopologs, and other manual games are noted.

Chapter 5 deals with the Navy Electronic Warfare Simulator (NEWS) and gam-

ing based on it. Chapter 6 touches briefly on computers and computer games. There is a useful glossary of war gaming terms and some well-chosen references on war games.

The weaknesses of this otherwise excellent book lie in its omissions, not in its contents. In particular, it lacks sufficient critical attention to the success of games and the Naval War College's experience. A full discussion of criteria for judging the success of a game is needed, and some observations on the years of gaming experience logged at the Naval War College itself would have been welcome. For example, just how successful has NEWS been?

This book is well worth reading. It does, however, point up the need for writings devoted to the overall theory of gaming to supplement the operational work.

James L. McKenney, *Simulation Gaming for Management Development* (Boston: Harvard University, Graduate School of Business Administration, 1967).

A solid, competent description of the organization, the goals, and the construction of a large-scale game for teaching and for experimenting with teaching methods at the Harvard Business School.

After an introduction to business gaming in general, the book describes the evolution of the Harvard Business School Management Game from earlier uses of UCLA simulation games #2 and #3. Its final form is quite complex and requires five-man firms; the faculty act as boards directing the industry.

The HBS Game was developed as a laboratory course in the required first-year MBA curriculum. In 1965, 670 students were organized into 21 industries of 7 firms each. Games ran for about two months, and 12 decisions were played. The game is probably somewhat more complex than the IBM FAME game and possibly somewhat less complex than the Carnegie Mellon Business Game.

Chapter 6 presents a valuable discussion of gaming research. Harvard Business School has emphasized the teaching use of the HBS Game and research on measuring its pedagogical effectiveness. For example, for teaching purposes, students are not required to define their corporate goals immediately in some plays of the game, but may be required to specify them after three periods of play.

The first test of the effectiveness of the game was an essay examination given to two sections of 90 students. (While the students in the gaming section had been playing the game, the students in the non-gaming section had prepared four integrated cases on production planning.) The examinations were graded according to their attention to three concepts of planning: (1) today's decisions create tomorrow's environment, (2) goals and plans should be carried out by a series of consistent decisions that are well adapted to the particular environment, and (3) functional decisions are interrelated (for example, marketing decisions affect production and vice versa). Statistical analysis of the grading showed the participants in the game as significantly better planners according to concepts 2 and 3. There was no significant difference in grades for the first concept.

Later, a broader experiment was conducted to evaluate the teaching objectives of the game. It used a series of multiple-choice questionnaires devised to test

whether students had learned certain planning concepts better through games than through case studies (the faculty had identified nine such concepts that they expected gaming to communicate better). The results showed no difference in the effectiveness of the two methods, and the experimenters concluded that the planning activity is too complex to evaluate without the independent judgment of a complete plan of analysis.

The author stresses the need for further research to evaluate the effectivenss of games in teaching. He advocates mixing games with ongoing courses and observes that the evidence favoring the use of games has been neither positive nor negative.

This is a careful, sensible, worthwhile book. Its goals are limited; its documentation is good; and it accomplishes its stated purposes. The study is valuable for those interested in using games of the business school level.

H.J.R. Murray, *A History of Board Games Other Than Chess* (Oxford: Clarendon Press, 1952).

This excellent encyclopedia of the origins, locales, and rules of play for over 270 board games is a sequel to the author's *History of Chess* (Oxford University Press, 1913). It is replete with factual detail and demonstrates a rare, painstaking scholarship.

Five basic types of board games are distinguished: (1) games of alignment and configuration, (2) games of war, (3) hunt games, (4) race games, and (5) *mancala* or cup-and-hole games.

Much more than a book on board games, this is a fascinating anthropological treatise that traces the many forms in which a common human interest in competitive play has been expressed.

For the novice, Chapters 1, 2, and 9 summarize well the main themes of the book; the expert will, of course, be interested in the other chapters as well.

Jean Piaget, *Play, Dreams, and Imitation in Childhood,* translated by C. Gattegno and F. M. Hodgson (London: Routledge & Kegan Paul, 1962; originally published in 1951).

Piaget's brilliance shines in this classic account of early learning through game playing, based on his many years of intensive clinical observation. The book is divided into three parts: imitation, play, and cognitive representation.

In the first part, Piaget describes how a child proceeds, from an initial absence of imitative behavior, through sporadic and systematic replication of immediate, visible cues, to more sophisticated imitations of non-visible, recalled cues, and eventually to the point where simpler behaviors are routinely combined in innovative and creative ways. This section concludes with a theoretical summary of the imitative process that is a clear, concise, and, given the evidence presented, plausible explanation of imitative learning through play.

In the second part concerning play, the author attempts to classify games into

gross categories of general or special activity, based on the foregoing imitative sequence. This taxonomic exercise is forced and is only marginally successful. Fighting, chasing, and social and family games are first placed under the general category, only to end up under the special category after several pages of qualification. Taxonomy is not Piaget's forte; observing children is. What is most useful in this part is his concept of play as an imitative, repetitive learning process. More precisely, play is defined as the repetition of assimilated behavior, originally learned through imitation, for the purpose of pleasure. The importance of this definition for the use of games as a training device is clear. Recent and continuing debates between the intuitional (Freudian) and the behavioristic psychoanalytic camps would place Piaget, with the likes of B. F. Skinner, in the latter group.

The third part treats ideas of cognitive representation behavioristically. Seen in that light, training replicates some as yet unattained and presumably desirable model of behavior. By repeated imitations of the model's characteristic patterns and procedures, the subject learns in time to replicate the model and thus assimilate it into his own cognitive makeup for subsequent use in whole or in part.

This important work provides key empirical-theoretical justifications for the use of games in diagnosis, therapy, and training. It is recommended reading.

E. S. Quade, ed., *Analysis for Military Decisions* (Santa Monica: The Rand Corporation, R-387-PR, November 1964).

This is a fine collection of seventeen articles taken from lectures given in a course on systems analysis, together with some supplementary material. Of particular interest to the gamer are several of the essays in parts II and III. "The Why and How of Model Building," by R. D. Specht, provides a simple and lucid introduction. It is followed by a discussion of selecting analytic criteria for operational purposes by R. N. McKean that provides a useful list of common criterion errors:

1. Ignoring absolute scale or cost of the objective.
2. Setting the wrong objective or scale of objective.
3. Ignoring uncertainty.
4. Ignoring the effect on other operations.
5. Adopting wrong concepts of cost.
6. Ignoring the time dimension.

The two excellent chapters on cost, "The Relevance of Cost" by Malcolm Hoag, and "Costing Methods" by G. H. Fisher and others in Rand's Cost Analysis Department, are of particular interest to both military and academic gamers. Close estimates of cost for a game are extremely difficult to ascertain, and military and academic gamers have tended to underestimate cost by orders of magnitude.

M. G. Weiner, in a fine chapter on war gaming, discusses the use of gaming as a training or heuristic device, for self-education, as a research tool, and as a stepping stone towards building a better model of the phenomenon being studied. The techniques of war gaming are considered for mathematical games, machine games, board and bookkeeping games, and games involving human umpiring. The steps in war gaming are noted as (1) determining the objective or purpose of the game, (2)

preparing the inputs and boundary conditions, (3) establishing the decision move and the adjudication mechanism, (4) playing the game, and (5) analyzing the game.

The chapter by Quade on mathematics and systems analysis provides a simplified overview of the role of mathematics and the computer in systems analysis for readers with no mathematical sophistication.

A useful recapitulation and checklist of the principles of systems analysis together with basic questions are provided at the end of the book.

Though this study does not have direct operational utility for the gamer, it provides an excellent supplementary text for the gamer who wants to know the basics of systems analysis.

E. S. Quade and W. I. Boucher, eds., *Systems Analysis and Policy Planning: Applications in Defense* (New York: American Elsevier, 1968).

Taking off from Quade's earlier book, *Analysis for Military Decisions* (preceding review), this book extends the scope and gives many more examples of the theory and practice of systems analysis.

The opening chapter, by Quade, discusses the principles and procedures of systems analysis. The other chapters deal with more specific topics. M. G. Weiner contributes a simple example of systems analysis that compares tradeoffs between ground power and air support, and in another chapter describes war gaming techniques comprehensively yet concisely. L. Attaway discusses the criteria and measurements of effectiveness for increasingly complex procurement decisions ranging from a simple aircraft engine, through a more complex interceptor decision, to the development of a comprehensive strategic budget. A. Madansky provides an easy-to-understand, competent treatise on uncertainty that considers utility theory and *a fortiori* and sensitivity analyses. G. H. Fisher gives an excellent introduction to resource analysis. Other chapters are devoted to cost-sensitivity analysis, technological considerations, cost studies, the nature of models, mathematical models of conflict, simulation, gaming, analyses of force policy and posture interactions, scenarios in systems analysis, the dangers and use of quantitative methods, and a listing of the pitfalls of building simulations.

As a thorough introduction to systems analysis, this is the definitive work. However, for practitioners working on very specific, sophisticated problems, the level of generality might make the book more frustrating than edifying. The 10-page bibliography suggests useful supplementary technical data.

A. Rapoport and A. M. Chammah, *Prisoner's Dilemma, A Study of Conflict and Cooperation* (Ann Arbor: University of Michigan Press, 1965).

This is an excellent study that simultaneously gives valuable information about experimentation with the Prisoner's Dilemma game and illustrates why it is so hard to make theoretical judgments on the basis of experimental study of the behavior of individuals in games.

The book is in three parts: (1) "Observed Regularities," (2) "Mathematical Theory," and (3) "Discussion and Projection." The first part describes in detail experiments with seven variations of the Prisoner's Dilemma. The second part discusses Markov chain models, equilibrium models with adjustable parameters, stochastic learning models, and classical dynamic models. The third part discusses testing the models and the problems of comparing population, and gives a summary of results.

To the reviewers, there are two major errors of omission in this work. First, the authors disregard the game-theoretic problems of using iterated matrix games. Information condition difficulties and payoff problems can influence the game considerably. Although Markov models and learning are considered, much more specification is needed about the characteristics of forgetting and of information-processing in lengthy plays. Second, the reader is not informed about the psychological and sociopsychological attributes of the players or about how to run experimental games in the social context of a laboratory. The Prisoner's Dilemma situation appears often in our society, though our society has established institutions that temper the dilemma aspects of the problem and preserve trust and fidelity to some extent. Much of the dilemma in the Prisoner's Dilemma arises, it seems, from the absence in society of institutions to set the context of the situation. The relation of the game to the real world should be addressed in any major work devoted to the Prisoner's Dilemma.

This book is of value to anyone interested in experimental gaming. However, as the authors were well aware, it represents only a first step on a probably long path toward understanding competitive and cooperative behavior.

B. Rome and S. Rome, *Communication and Large Organizations* (Santa Monica: System Development Corporation, SP-1690/000/00, September 1964).

This report contains two lectures on the gaming and simulation method called LEVIATHAN. The first describes the methods, and the second, experimental results. The LEVIATHAN work was done over a period of several years at the System Development Corporation. Its objective was to develop and perfect a method of studying communications in large social organizations. The method comprises a theoretical framework, a system of computer programs, designs for a series of laboratory simulations, a repertory of experimental controls, and quantitative measurements of organizational performance. The simulations were conducted over a period of three months and employed 20 to 30 subjects, who interacted with hundreds of robots and with each other through a real-time computer arrangement.

Several advantages are claimed for the method. First, it gives abstract and general results. Second, all interactions between subjects and robots take place through the computer, resulting in a kind of symbiosis between live subjects and computer programs that can be controlled by experimenters. Third, the computer programs monitor step by step the transformation of individual behavior into organized social behavior. Fourth, the computer automatically observes and records what the subjects say to each other. Fifth, the operation partakes of the standard benefits of computer-based laboratory work.

In the first lecture, the authors recall the dictum that science originates when theory and experimentation are united to yield significant results. They proceed to describe LEVIATHAN's experimental social hierarchy, formal organization of authority, the domain, units of work, function of the work codes, the implementation of management decisions, management controls, traffic, priority, production, and manpower.

Using this framework, a social hierarchy with six levels of control was simulated in 1963 and 1964. At the lowest level were 704 robots in 64 working squads. The squads were directed by live officers, staff, and staff assistants, consisting of 16 group leaders, 4 branch heads, and a commanding officer. The entire center reported to 1 chief. Graduate students were the live participants. Tags were used to describe the communiqués in the system, which included the following information: subject, source, area, precedence, source evaluation, information evaluation, and addressee.

A common type of experiment performed with this system was an exercise in the summer of 1963 to show what happens when managers ignore their neighbors and how the system's performance can be improved when managers take into account the functioning of all the elements in the system (adopt a "system perspective").

The lecture is effectively illustrated with charts, including, for example, a depiction of all the possible one-way communication links among 21 persons.

The second lecture, on the results of the experiments, begins by suggesting the use of the word "heterarchy" (coined by Warren McCulloch) instead of "hierarchy," to better suggest the multidimensionality, interlocking flow, and multilateral distribution of authority in large organizations.

Four major experiments were performed. The first used the basic system of hierarchically organized feedback, encompassing flow information, manpower information, and the overall structure of information in the program. The second experiment introduced a crisis into the hierarchy. The third experiment used reports by exception, and the fourth involved a change in the organization.

One of the lessons that emerged was that the laboratory organization responded most sensitively to certain explicit experimental operations and conditions. Debriefings demonstrated the value of trend information and of the system approach. Changes in organization charts helped to refine the authority function and territorial jurisdiction. Crisis assessments underscored the importance of priorities in communiqués. As a result of the four experiments, a language called the General Operator-Computer Interaction program system (GOCI) was constructed. It was used, in a fifth experiment in 1963, to generate decision trees.

In 1964, LEVIATHAN was used as a teaching aid for executive training. The results are not documented. The second lecture closes with comments on ongoing research and discussion of the need for further study of how well large organizations are equipped to satisfy plural system objectives.

One is overwhelmed in reading this report. The very name LEVIATHAN suggests its fatal flaw. Despite the probably considerable talents of the authors, who were the ones primarily responsible for the work, its scope was too great for less than a large group to manage. The authors' goals and their willingness to tackle a problem of this magnitude are admirable. The idea of constructing an enormous, automated laboratory for the study of organizations is highly attractive, but it would take many millions of dollars, much time, and prodigious organizational coordina-

tion to establish a sufficiently large-scale enterprise of competent, diverse professionals. The authors were evidently not able to command the resources to achieve the necessary cost-effectiveness, colleague cooperation, and quality of programming and of validation and data-processing of outputs (to name a few of the factors on which the success of such a program depends).

This account is worth reading as an object lesson. The LEVIATHAN experiment represents a tragedy of malproportion. Either a more modest goal with smaller-scale experiments and greater theoretical and analytical manipulation of organizational relationships, or, given the stated goal, a large, complex group of talents such as described above might have produced more viable results.

Fred Schuh, *The Master Book of Mathematical Recreations* (New York: Dover, 1968; originally published in 1943).

This is a rare gem of a book that examines the logical and mathematical underpinnings of a large number of games and puzzles. Even the simplest—tic-tac-toe, dice, matchstick puzzles—have underlying properties. Surprisingly little work has been done on the mathematics of entertainment games, except on probability theory in roulette and dice. This is the only comprehensive treatment that exists.

Hundreds of games are classified according to their mathematical properties. They include domino puzzles, tic-tac-toe, weights problems, disks puzzles, binary puzzles, transportation puzzles, games based on stacks of objects, permutations and probability, dice games, bridge, gambling games, encirclement games, wolf and sheep, catch the giant, the soldier's game, the game of five, least-move solutions to permutation problems, network puzzles, line and dot games, the knight's tour, puzzles on sums, problems involving kinematics, and the climbing monkey puzzle.

General methods for solving games and puzzles are described in great and clear detail. The average college student should have little difficulty with the mathematics or other technical material. Gamers of any specialty will find Schuh's gaming theory and method of interest. Here is proof positive that mathematics can be not only rewarding but great fun.

Arthur I. Siegel and J. Jay Wolf, *Man-Machine Simulation Models* (New York: John Wiley & Sons, 1969).

This brief book presents the results of ten years of research and experimentation on systems engineering and human factors analysis by Applied Psychological Services, Inc. The aim was to develop quantitative techniques for assessing the performance of systems in which personnel performance and interpersonal relations are considered important to the system's total effectiveness. The examples reflect the U.S. Air Force's early interest in this activity.

There are seven chapters: Modeling and Simulation; Logic of Unitary or Dual-Operation Simulation Models; The Result of Application of Such Models; Group Simulation, Qualitative and Conceptual Considerations; Group Simulation, Quan-

titative Considerations; Tests of a Group Simulation Model and the Predictive Validity Simulation.

Two kinds of computer-based simulations are discussed. The first involves the modeling of the activity of a one- or two-operator man-machine system as in landing an aircraft, firing an air-to-air missile, and searching out, detecting, and classifying a hostile submarine. The second model, geared to larger systems, must be able to simulate the action of dozens of persons working at several independent stations. Both models stress psychological or psycho-social variables.

The second and third chapters deal with the simpler type of simulation, which is appropriate for answering such questions as, Can an average operator be expected to complete a certain task on a certain machine in a certain time? How is the probability of success affected if operators are slower or faster than average or if more or less time is allotted? and, What is the distribution of operator failures as a function of operational stress, tolerance, and operator speed? Goal-setting, aspirations of goal achievement, and interaction between partners if more than one person is involved must all be taken into account. An example of this type of model-building is given. Applications are suggested for carrier landing, missile-launching, and in-flight refueling and interception operations.

The remaining chapters deal with the more complex task of group simulation. In contrast with the one- or two-man model, which studied stress and other variables of relatively short missions, the group model is used to predict the qualities of larger man-machine systems such as system efficiency as a function of crew size and mission time; crew morale and cohesiveness during a mission; time devoted to equipment repairs; proficiency of crew members; and man-hour loadings and overtime.

As noted above, the emphasis is on the psychological aspects of performance. Chapter 4 discusses the theory behind this type of model-building. Pertinent variables include leadership, group size, personality, task performance, social-cultural characteristics. Chapter 5 treats the modeling and quantitative considerations. The efficiency of group performance is defined as a function of communications, group proficiency, environment, and psycho-social reaction. The inputs to the program include mission data, equipment data, and personnel data. Parameters for initial proficiency values, crew morale and cohesiveness, current days workload, selection of work group, and communications efficiency must all be set.

In Chapter 6 a hypothetical underwater craft system is simulated by way of example. The importance of validation is discussed, by which is meant "the determination of the ability of the model to predict empirical, independently derived, outside criterion data." Three categories of outside criterion data are suggested: (1) results for which objective data were available from the U.S. Navy; (2) results that could be estimated by interviewing crew members; and (3) results that were not amenable to outside verification but had to be confirmed according to their coherence or agreement with logical expectation.

This is a careful and useful study, worthwhile particularly for those concerned about how to treat human factors in conflict simulations. The main drawbacks are the omission of (1) discussion of the costs of this work; and (2) sensitivity analyses (it is merely noted that parameters may be changed fairly easily, but not the circumstances in which they should be changed and how much it would cost). It would also have been desirable had the section on validation considered alternative means such as field testing and compared the costs and feasibility of the alternatives.

Simulation: Technical Journal of Simulation Councils, Inc. **(La Jolla: Simulation Councils, Inc., 1963 to date).**

Simulation Councils is a technical society that was established "to advance the design and use of computers and similar devices employing mathematical or physical analogies and to widen their applications in all fields." It is affiliated with the American Federation of Information Processing Societies and the Institute of Electrical and Electronic Engineers Computer Group. The articles in this monthly publication vary from mediocre to very good. The bias is primarily toward the engineering side of simulation and gaming, with a well-intentioned but somewhat naïve interest in social simulation. In this lies a danger that the organization might fall under the sway of grand schemes of social engineering that ignore the complexity of human behavior. Articles on "world simulations" that underscore "social costs" or "effects on the environment" appear with depressing regularity.

Simulation is no substitute for knowledge of a subject. It can be a great help to those who do know their subject. Problems involved in modeling society, the city as a system, or world simulations are not primarily problems in simulation. They are problems in observing, understanding, and abstracting from the human systems in which we are embedded. It would be pleasant to believe that electrical engineering combined with computer capacity can solve all the problems of the world. Some of us are a little more pessimistic.

United States Army Strategy and Tactics Analysis Group, *Directory of Organizations and Activities Engaged or Interested in War Gaming,* Report AD403272 (Washington, D.C., 1962).

This is an extremely valuable summary of war gaming activity for its time. It documents work in the United States, England, and Canada, allowing the reader acquainted with the subject to form a good picture of the nature and scope of activity in the early 1960s. The treatment could have been much enriched if each descriptive listing had included summary information on the study's uniqueness and purpose, briefings, validation, applications, and related work. Though this is not the most recent catalogue produced by STAG and other gaming organizations, the reviewers believe it to be the best.

M. G. Weiner, *War Gaming Methodology* (Santa Monica: The Rand Corporation, RM-2413, July 1959).

This is a first-rate, no-nonsense handbook and guide to war (and other) gaming. The result of asking "how to" and "what for" of the SIERRA game series run for the Air Force at Rand in the late 1950s, it has stood the test of time admirably.

SIERRA was established to examine possible limited-war situations and to develop a methodology for their study by small but balanced staffs. Limited-war studies require a full complement of air, ground, sea, and logistics actions. Economic, political, and military factors all interact. War gaming is useful in the following ways:

1. To aid training.
2. To test war plans.
3. To organize and analyze large groups of data.
4. To force decisions to be made and to permit specific, concrete interaction among factors.
5. To check the credibility of decisions.

Games usually involve large quantities of data and require specialists for the players' teams and the control teams. The players must have first-hand knowledge of military and political organization, procedure, and doctrine.

Preparing for a war game exercise is a complex process involving at least four activities:

1. Selection of the geographical area and time period.
2. Collection of appropriate data concerning the area.
3. Organization and extrapolation of the data.
4. Preparation of the game context.

Forms of two-sided gaming are discussed. A two-sided war game is one in which both sides submit their moves simultaneously to the control team, continuing until control decides on a termination point. Variations include open information; closed information and predetermined form; and closed information and a situation-determined form.

In a two-sided game with open information (also called "open scenario"), the preparations of each side, including military forces, political and military objectives, and attack times and dispositions, are available to the other side. The initial military situation is a matter of common knowledge. The advantage of this type of game is its emphasis on military capabilities and reduction of political play. It is faster and better-defined than other two-sided games. Open information permits the isolation of some of the critical factors affecting the use of military force.

In a two-sided game with closed information and predetermined form, each side recieves a prepared scenario that gives some information not available to the other side; only the referee is omniscient. In addition, the scenario places restraints on each side that exert a considerable influence on the course of the game. The advantage of this type of game is that it compels each side to do a large amount of contingency planning. The disadvantage is that it takes longer to play and demands more complex analysis and better judgment. There is also a danger that the restraints imposed by the scenario will be too artificial. The two-sided game with limited information and situation-determined form also starts with a prepared scenario, but without the restraints. Restraints are imposed and removed by the control team during the game as a function of the play.

Each player team represents one or more countries and has four to six members. The team must keep a record of the game in logs and overlays that indicate operational details. As the game begins, the team chooses its strategic, then its tactical, objectives. Detailed moves are plotted, and a plan of integrated air, ground, and sea operations is drawn up. The plan specifies the move that will be attempted, the war date and time, the forces committed, the objective of the target, and other important information.

The control team's job is to make continuous evaluation of the game, ensuring

the integrity of the play and monitoring the timing. Moves, including reconnaissance, logistics, and administrative operations, can be assessed as political, combat, or non-combat. The control team might consist of the game director, his assistant, air, ground, and sea assessors, and political, logistics, and intelligence advisers. (Participants in the SIERRA games included a control team of five to eight people; a gaming staff of thirteen to twenty; and several clerical personnel.)

The basic unit of play in a war game is the move cycle. This consists of one complete round of moves by blue and red and the evaluation and assessment by control.

Several special methods of play have been developed to expedite games and to handle special situations. Three important ones are the projection method, the meshing method, and the series method. Projection is used when a game has reached a stage at which available options for further action seem reasonably clear. Then, one or both player teams and control may spell out the subsequent course without detailed gaming. In the meshing method a branch point is reached that is so critical that a subsequent game is required. This new game, called a "variant," begins at the branch point and implies pursuit of another course of action.

The series method calls for changing the initial conditions and producing a series of games. Two further types of play may be adopted in later games of the series. They are joint adjudication play and seminar play. With joint adjudication, the opposing teams plan their overall tactical operations separately over a certain, extended period of the war. Then, these plans are discussed, precise moves are determined, and conflicts are resolved in joint meetings of the opposing and control teams around a war map. The game is speeded by use of the extended move cycle, and paper work is reduced. On the other hand, this method sacrifices considerable detail and prevents exploring the role of intelligence-gathering. In seminar play, the three teams work together around the war map continuously, from the beginning of the game.

Post-game analysis can focus on (1) overall game evaluation, (2) a single aspect, (3) causal factors governing the use of the specific forces, or (4) identification of unforeseen problems that arose during the game. Overall evaluation, the most common, is handled by writing a critical narrative showing how gamed actions contributed to the final outcome. This synthetic history serves several purposes. It may be reviewed to estimate the effect of certain actions taken by each side, or it might provide a test bed for exploring the possible effects of changing some of the initial functions of the game.

This excellent report is recommended for gamers of all levels of competence and degrees of interest.

Richard L. Wing et al., *The Production and Evaluation of Three Computer-Based Economics Games for the Sixth Grade* (Westchester County, New York: Board of Cooperative Educational Services, 1967).

This is a report of an experiment by the Westchester County Board of Cooperative Educational Services, with IBM, to produce and evaluate computer-based games as self-teaching devices in economics for sixth-grade students. In 1965-1967, three

such games were devised and two of them tried out on an experimental group of 26 students.

The report is in five parts: (1) the theoretical basis for the experiment, (2) the description of the games, (3) the experimental procedures and the results, (4) implications for education, and (5) references and bibliographies. Several appendices discuss subjects such as the functions of the computer in economic games.

The first part, on theory, gives an incisive outline of the process of education and the computer's possible place in it. Of the five phases of the educational process—purposive, diagnostic, prescriptive, instructional, and evaluative—the last four could benefit from the application of computer technology. Large-scale storage capability is needed, however, to accept more information about students' needs and accomplishments.

It is suggested that electronic media may prove to be the most effective means of individualized instruction for some kinds of learning. To be successful, however, individualized instruction requires flexibility in the following aspects of the instructional phase: content, scope of content, pace of learning; sequence, structure, or order in which topics are presented; difficulty of subject matter or learning experience; mode of presentation; agent of control (teacher, student, environment); style or mode of instruction (e.g., Socratic dialogue); and degree of interaction between teacher and student. It is claimed that computerization could improve the flexibility of many of these aspects, at least for some kinds of learning.

The rationale for the work included the following hypotheses:

1. For certain kinds of instruction in the social studies, the use of a simulated environment mode can result in at least as much learning as conventional methods.
2. For certain subjects the simulated environment mode will save instructional time.
3. For certain kinds of learning, such as the comprehension of economic principles, the game technique will result in the formation of concepts of better quality than those produced by conventional methods.
4. The simulated environment mode, at least in the game form, is a suitable method of instruction for the upper elementary grades in the subject fields tested.

The three games were called the Sumerian game, the Sierra Leone game, and the Free Enterprise game. The first two, which comprised the formal experiment, used an IBM 7090 time-sharing system and the FORTRAN Assembly Program as coding language. The Free Enterprise game was completed after the formal experiment.

The Sumerian game begins with a 20-minute introductory slide lecture driven by a tape recorder. The student learns that he will play the role of ruler of a city-state in the ancient land of Sumer about 3500 B.C. As the game proceeds, he is led through a series of progressively more complicated decisions. For instance, one decision is, given a crop of a specified size, how much grain is to be set aside for next season's planting and how much is to be stored against famine? The game has an explicit and simple mathematical structure, is well documented, and gives simple messages to the players. Random disasters are also introduced into the game through a realistic Monte Carlo procedure.

In the Sierra Leone game, the student's role is that of an American economic adviser to the young African nation of that name. The objectives are that the student (1) gain an understanding of some of the problems of newly independent countries in Africa, (2) learn about the geography and recent history of Sierra Leone, and (3) become familiar with some economic principles. During the game, the student is expected to learn, for example, that it is desirable to raise agriculture above the subsistence level; that large-scale agriculture can be more efficient than individual, small farms; that the law of diminishing returns operates when excessive labor and capital are invested in a single piece of land; and that variation in the three main factors of production (land, labor, and capital) increases production.

This game has built-in rewards for the student. He begins as second assistant affairs officer. If his decisions during play promote economic progress, he gains points and can advance to first assistant affairs officer and to chief affairs officer.

A board-game version of the Sierra Leone game was also constructed and tried out on eight subjects. The testing of its utility was inconclusive.

The Free Enterprise game was written by J. Leonard of the Social Relations Department at Johns Hopkins University. In the first part of the game the player plays the owner-operator of a small toy store. In the second part of the game, he branches out into manufacturing surfboards. The toy store phase can take 5 to 8 hours depending upon the player's decisions. The surfboard segment takes 2 to 4 hours. It is intended that the player spend 30 to 45 minutes each day playing the game, although he may stop at any point, starting there in a subsequent session.

The game is divided into one-month segments in simulated future time. It is only a little simpler than the type of business game played in graduate schools, except that it is a one-person situation and hence the competitive aspects are eliminated. The player receives a full page of printout concerning the state of his enterprise.

The objectives of the experiment can be phrased in seven questions:

1. Is it possible to program complex economic games for a time-shared computer and run them without intervention by human instructors?
2. How effective is this mode of instruction? Do students learn more? Do they retain what they have learned longer? Do they learn with greater understanding? Or faster?
3. Is there any saving of instructional time?
4. What is the relationship between intelligence and learning by simulation techniques?
5. Do students appear to enjoy playing instructional games?
6. In what ways do computer-based games meet certain theoretical criteria for the individualization of instruction?
7. Can games developed in one place be successfully set up elsewhere?

The findings revealed that the game method was not noteworthy for teaching facts. The games taught some concepts well, particularly the interpretation of graphs and diagrams, others poorly. As for consumption of time, the control group (where the teacher, not a computer, monitored the games) spent one hour a day for three weeks on each of the two games, approximately 30 hours for both. In the experimental group, average pupil time on the Sumerian game was 10 hours and

15 minutes, with a range of almost 7 to 14 hours. The average time on the Sierra Leone game was 5 hours and 5 minutes, with a range of 4 to 8 hours. The average for completing both games was 15.5 hours. Thus, the control group appears to have spent twice the time of the experimental group.

All students enjoyed playing the games. Some found the Sumerian game repetitious. The majority thought half a day sufficient to learn the system. Typing was not a source of trouble. Most pupils enjoyed role-playing. Most thought that they learned a lot from the games. The computerized games appeared to satisfy most of the criteria for flexibility in individualized instruction. The games apparently can be transferred to different locations without much difficulty.

In all, the computer-based economic games appeared to be at least as effective in teaching principles of economics as the classroom method. The control group showed somewhat more understanding of economic principles several months after game play than did the experimental. In general, the more intelligent students learned more playing the game than did the less intelligent students. There was only a very slight connection between intelligence and the time it took pupils in the experimental class to complete the game.

Computer-based instructional systems currently in use cost at minimum $1 to $3 per student-hour. Costs are expected to diminish.

In discussing the implications of the experiment and its findings, the authors point out some of the problems that educators may encounter when they adopt computer-assisted instruction (CAI). Among them are resistance by teachers; opposition to all CAI if the first programs are poorly designed or do not justify the use of a computer; and adverse public reaction.

The adoption of CAI will also affect school operations. In particular, the administration acquires the extra tasks of (a) deciding among CAI systems, (b) obtaining funds in order to rent computers, (c) scheduling students, (d) hiring flexible, qualified CAI personnel and setting their salaries, (e) managing the logistics of individualized instruction, (f) training the teaching staff in the use of CAI, (g) explaining CAI to parents, and (h) interpreting even the rudiments of computers to boards of education.

The educational system will be confronted with problems of scheduling, examinations, system articulation (should education be subdivided into elementary, junior high, and high schools?), and miscellaneous institutional rigidities. As regards curriculum, CAI is expected to allow much greater variety and flexibility in programs. CAI will not replace teachers, but will cause their roles to change. The use of computers could have broad effects on teaching methods, in particular diagnosis, prescription, instructional modes, the use of materials, and evaluation.

The report ends with a large bibliography on CAI and a bibliography on games, gaming, and allied topics.

This is an important piece of work, not only for its undoubtedly high quality, but also for its relevance to the problems presented by the use of games for instruction. The tone of the report is scholarly and serious; the methodology is clear and rigorous; and the results are interpreted cautiously. This is in admirable contrast to the many works of advocacy on the subject.

It would be easy to criticize the authors for having chosen such a specialized subject to teach and experiment with. It would be easy, but inappropriate. Experimental work can also be criticized for not looking at the big picture. But in the

behavioral sciences, and in teaching, one often has to be able to draw preliminary sketches and see small pictures well before the big picture can be grasped. In a field replete with unsupported assertions and theological statements, it is a pleasure to find work of this caliber.